NO COPIES RECEIVED.

LIBRARY OF CONGRESS OFFICE OF Register of Copyrights. SEP 8 1899

2nd COPY DELIVERED TO THE Periodical Dept. SEP 8 1899

SEP 8 1899

Standard Size, 9 x 12. SEPTEMBER 7, 1899. Price Six Cents.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE AMERICAN MACHINIST PRESS,

Vol. 22. 218 WILLIAM STREET, NEW YORK. No. 36.

Contents and Index to Advertisers, Page 12

A COMPLETE LINE OF

FOR PIPE.

Tools for Threading Pipe and Bolts.

"Duplex" dies which are instantly adjusted or opened, and are easily sharpened. When at work they are led straight by adjustable centering guides. The best of threads are obtained with the greatest possible ease and speed.

Many other advantages are found in the use of "Duplex" Die Stocks. Standard threads for any country in the world furnished.

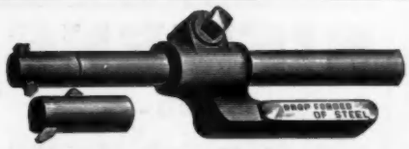
FOR BOLTS.

SEND FOR CATALOG.

The Hart Manufacturing Co.,

22 Wood Street, Cleveland, Ohio, U. S. A.

Schuchardt & Schutte, Bertin, Vienna, Stockholm, Brussels.



Charles Churchill & Co., Limited, London.

THIS ADVERTISEMENT

Will be read by thousands of satisfied users of our tool holders in every part of the known world and we utilize it as the very best medium through which to inform them of the following points:

HEREAFTER WE WILL ALLOW 20 % DISCOUNT FROM OUR LIST PRICES TO THE CONSUMER.

We have now in preparation the following new tools:

Offset Cutting-off Tool. 7 Sizes. **New Threading Tool.** 4 Sizes. **Special Planer Tool.** 5 Sizes.

THESE NEW TOOLS WILL BE READY JANUARY 1ST, 1900.

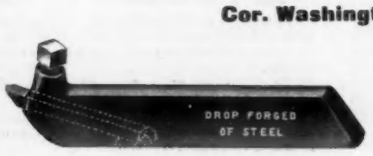
A GOOD THING to have in the shop is a set of our Patent Drill and Reamer Holders. They don't cost much and are very HANDY.

EVERYBODY to-day recognizes the enormous advantage and economy of the inserted cutter principle in iron working tools and WE ARE SPECIALISTS in the application of that principle to lathe and planer work. 56 SIZES and SHAPES enable us to do this successfully and to an extent heretofore undreamed of.

ARMSTRONG BROS. TOOL CO.,

Cor. Washington and Desplaines Streets, Chicago, Ill., U.S.A.

G. Koeppen & Co., Moscow.



WRITE FOR NEW CATALOG.

Pacific Tool & Supply Co., San Francisco.

Some Shops

add very materially to their profits by watching the little leaks and devising ways of stopping them.

There's that little matter of oil that's thrown out on chips, bolts, nuts, etc.—thrown out, wasted, when, aside from being discolored, it's practically as good as it ever was.

Some shops that use as little as three barrels of oil per year have bought a Roper Centrifugal Oil Separator and are reclaiming such oil, using it over and over.

Maybe there's some extra profit for you in this scheme. You can easily find out by addressing the

American Tool & Machine Co.,

Leading Manufacturers of Sugar Machinery,

109 BEACH STREET,

Founded 1845. BOSTON, MASS.
Incorporated 1864.

COMBINED SEPARATOR AND FILTER.

Sent on 30 days' trial. Write for prices.

Springfield Separator Co.
Springfield, Vt.

Whitney Makes Everything

In Wood-working Machinery, and everything that Whitney makes is as right as brains and capital and long experience can make it. Whitney's fine machines are correctly shown and described in Whitney's handsome book, which is free to interested persons.

Baxter D. Whitney,

Winchendon, Mass.

UPRIGHT DRILLING MACHINES.

20″
21″
25″
28″
30″
36″

Our Exclusive Specialty.

It is not what you say concerning yourself, but what others say of you that counts in the business world.

ROCHESTER, N. Y.,
Sept. 24, 1897.

J. E. SNYDER, Worcester, Mass.,

Dear Sir:—Yours of the 22d is at hand and noted. Enclosed find our check in settlement of the New 36-inch Drill Press. We purchased a 30-inch machine from you several years ago and were so highly pleased with it that when we decided to purchase another we were pleased to find that you had introduced several new features and improvements and we decided to place our order with you for the same. It gives us pleasure to state that it is first-class in all its details, quick and convenient to operate and adjust, and accurate in its production. We are more than pleased with it and you are at liberty to refer to us at any time.

Very truly yours,
THE J. S. GRAHAM MACHINE CO.,
JOHN KANE, Vice-Pres.

Catalog free. **J. E. SNYDER, Worcester, Mass., U.S.A.**

Get a Separation—

from that dirty, smoky, slow-working old coal or coke furnace at once—get it before your temper is spoiled and before any more of your earnings are swallowed up by it. You can prove that it is untrue to you—that it is wasteful of your profits and that it occupies too much of the time of your workmen. You can prove that it's most everything that a good furnace ought not to be, and that it has none of the qualities that would make it lovable to you.

Then pay court to a Gas Furnace—an American Gas Furnace—the even-tempered kind, that will give your men no excuse for loafing around, that will help you to save your money, and that will do all that a good Gas Furnace can do for your peace of mind, your profit and comfort. Get one of that kind and you'll be "happy ever after."

The American Gas Furnace Co.,
23 John Street, New York.

Chas. Churchill & Co., London, Birmingham and Glasgow. Schuchardt & Schutte, Berlin, Cologne, Vienna, St. Petersburg. H. Glaenzer & Perreaud, Paris.

"Penny Wise and Pound Foolish."

The man who persists in operating babbitted boxes when he knows that his neighbor has, by discarding them, saved double their market value every year, is an exemplification of the above.

Hyatt Roller Bearing Co.,

133 Liberty St., New York City. HARRISON, N. J.

SIEMENS

--- AND ---

HALSKE

ELECTRIC COMPANY OF AMERICA.

Main Office and Works:

CHICAGO, ILL.

Electric Dynamos,

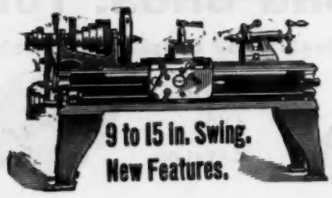
Belt Driven and Direct Connected.

Motors,

Arc Lamps,

Meters, Etc., Etc.

BRANCH OFFICES { New York—Havemeyer Bldg. Boston—71-73 Broad St. Philadelphia—Land Title Bldg. Cincinnati—Neave Bldg. St. Louis—Laclede Bldg. Denver—412 Seventeenth St. Grand Rapids—22 Norris Bldg. Salt Lake City—Trent Eng. and Mach. Works. San Francisco—598 Parrott Bldg.



The "Sebastian" Lathes

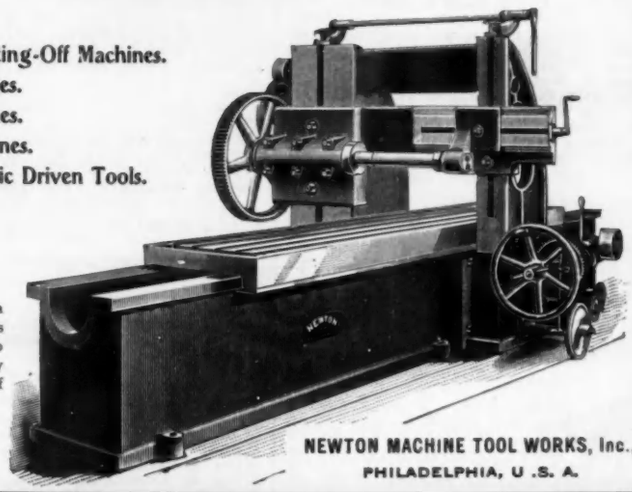
combine high quality with effective and economical operation, in a very unusual degree, and can be depended upon, at all times, for thoroughly satisfactory and profitable service. Send for interesting details.

Sebastian Lathe Co., 117 & 119 Culvert St., CINCINNATI, OHIO.

AGENTS—Selig, Sonnenthal & Co., London, England. Jn. Tragardh & Co., Goteborg, Sweden. E. Sonnenthal, Jr., Berlin, Germany. R. S. Stockvis & Zonen, Rotterdam, Holland.

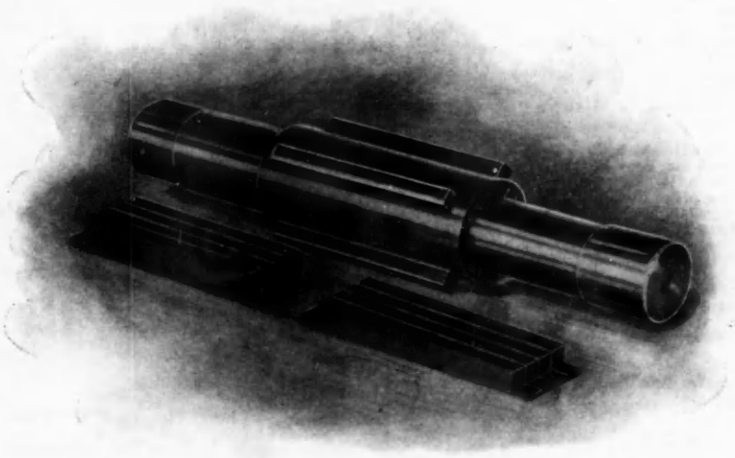
NEWTON

Cold Saw Cutting-Off Machines.
Milling Machines.
Boring Machines.
Slotting Machines.
Portable Electric Driven Tools.



Eight sizes plain milling machines 15 in. x 15 in. to 72 in. x 72 in., any desired length of carriage.

NEWTON MACHINE TOOL WORKS, Inc.,
PHILADELPHIA, U .S. A.



Ever Figure Up How Much Solid Mandrels Cost You

every year? Ever compute the cost of the time that's lost in hunting through a lot of them for the right size, and then, perhaps, not finding it? Just figure up, roughly, in round dollars, what these two items of expense would probably amount to, then ask us how Nine of Nicholson's Patent Expanding Lathe Mandrels can be made to fill the place of all your solid mandrels, for one to seven inch holes, at about one quarter the cost of those solid mandrels. We make prompt deliveries. Send for catalog.

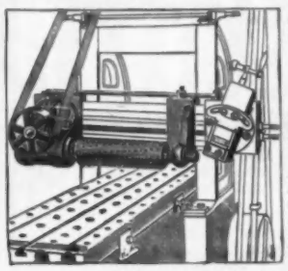
W. H. NICHOLSON & COMPANY,
MANUFACTURERS OF MACHINERY SPECIALTIES,
WILKES-BARRE, PA., U.S.A.

THE CUMBERLAND IRON AND STEEL SHAFTING CO
TURNED AND GROUND CUMBERLAND. MD.
HIGHLY POLISHED SHAFTING. SEND FOR PRICE LIST U.S.A.

The Cumberland Iron & Steel Shafting Co.,
Turned, Ground and Highly Polished Iron and Steel Shafting, Cold Rolled, Cold Drawn and Compressed Round, Square, Flat and Hexagon Steel.
CUMBERLAND, MARYLAND, U. S. A.

Arbres en acier tournes et aleses. Demander le prix-courant.
Gedrehte und polirte Stahlwellen Preisliste auf verlangen frei.
Cilindros de acero tornados y alisados. Se facilita lista de precios.

MILLING MACHINE



combined with any **Iron Planer** swivels from Horizontal to Vertical. Do not plane surfaces that should be milled or mill surfaces that should be planed.

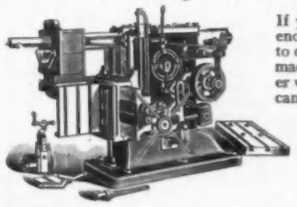
SEND FOR CATALOG.
The Adams Company, Dubuque, Ia.

We Plane Steel Gears

faster and better than you mill cast iron ones. You wouldn't ask the reason after seeing the chips. They roll up like chips from a lathe tool. We don't scrape them off, but cut them off. Cutter has a top rake you know. Let us tell you more about it.

The Fellows Gear Shaper Co.,
SPRINGFIELD, VT.

Morton's Draw Cut Shaper with Keyseating Attachment



If you do not have enough keyseating to employ a special machine this Shaper with attachment can do your work. It will cut a key-way ⅝ in. wide, 7-16 in. deep and 14 in. long; time 8 minutes.

MORTON MFG. CO., Muskegon Heights, Mich., U. S. A.

Eastern Branch: 126 Liberty Street, New York, N. Y.; Walter H. Foster, Manager. Glasgow Office: 40 St. Enoch Square; James Ritchie, Manager. Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm and St. Petersburg. Adphe. Janssens, Paris, France. Selig. Sonnenthal & Co., London, England.

SEND FOR CATALOG.
WORCESTER MACHINE SCREW CO.

MANUFACTURERS OF
Set, Cap and Machine Screws, Studs, &c.

HYDRAULIC PRESSES

And Special Machinery Designed and Built. . .

BRANDYWINE MACHINE WORKS
WILMINGTON, DEL.

HOW TO SUCCEED IN LIFE.

WRITE FOR OUR FREE ILLUSTRATED BOOK

(120 pages) showing how thousands are successful and gaining better positions and salaries studying at home by our correspondence system.

We teach **Electrical Engineering**, Telephony, Telegraphy, X-Rays, Electro-Chemistry, **Mechanical Engineering**, Electric Mining, Elementary Mathematics, **Mechanical Drawing**, etc., **BY MAIL.** THE ELECTRICAL ENGINEER INSTITUTE OF CORRESPONDENCE INSTRUCTION, Dept. 4, 120 Liberty St., NEW YORK.

I consider the Electrical Engineer Institute to be conducted by Messrs Clayton and Mailloux to be of great help to those who desire an Electrical education.
Thomas A. Edison

Index to Advertisers.

	PAGE
Acme Machinery Co	16
Adams Co., The	11
Albro-Clem Elevator Co	43
Almond, T. R	49
American Gas Furnace Co	2
American Saw Co	10
American Tool & Machine Co	2
American Tool Works Co	41
Armstrong Bros. Tool Co	1
Arthur Co., The	8
Backus Water Motor Co	54
Baird & Co., Henry Carey	49
Baird Machinery Co., U	44
Baker Brothers	49
Baldwin, Davidson & Wight	49
Ball Bearing Co	16
Barker & Chard Mach. Tool Co	13
Barnes & Co., W. F. & John	44
Beaman & Smith	40
Becker-Brainard Milling Mach. Co	51
Bement, Miles & Co	10
Besly & Co., Chas. H	56
Bethlehem Foundry & Machine Co	48
Bethlehem Steel Co	55
Betts Machine Co	5
Bickford Drill & Tool Co	3
Bignall & Keeler Mfg. Co	3
Bilgram, Hugo	39
Bliss Co., E. W	6
Boston Gear Works	49
Bradford Mill Co., The	53
Brandywine Machine Works	11
Bristol Co	56
Brown Hoisting & Conveying Mach. Co	55
Brown & Sharpe Mfg. Co	56
Brown & Co., R. H	9
Buffalo Forge Co	56
Builders Iron Foundry	4
Bullard Machine Tool Co	15
Bullock Electric Mfg. Co	43
Burt Mfg. Co	38
Caldwell Co., W. E	54
Carborundum Co., The	40
Card Mfg. Co., S. W	44
Case Mfg. Co	7
C & C Electric Co	45
Chandler & Taylor Co	54
Cincinnati Mach. Tool Co	49
Cincinnati Milling Machine Co	53
Cincinnati Radial Drill Co	55
Cincinnati Shaper Co	16
Clark, Jr., & Co., Jas. R	44
Cleveland Ball & Screw Co	8
Cleveland Gear Works	38
Cleveland Twist Drill Co	56
Coffin & Leighton	42
Columbus Machine Co	54
Cook Co., Asa S	9
Cornell Machine Co	54
Crescent Steel Co	7
Crosby Steam Gage & Valve Co	7
Cumberland Iron & Steel Shafting Co	11
Curtis & Co., Mfg. Co	49
Curtis & Curtis	42
Cushman Chuck Co	9
Dallett & Co., Thomas H	3
Davis Machine Co., W. P	16
Dayton Globe Iron Works Co	54
Detrick & Harvey Machine Co	40
Detroit Lubricator Co	54
Dietz, Schumacher & Boye	52
Dixon Crucible Co., Joseph	40
Doan & Co., J. B	14
Draper Machine Tool Co	50
Dreses, Mueller & Co	52
Dwight Slate Machine Co	44
Dyson & Sons, Jos	46
Eames Co., G. T	48
Eddy Electric Mfg. Co	49
Electrical Engineer Institute	11
Errington, F. A	9
Evans Friction Cone Co	39
Falkenau, A	43
Faneuil Watch Tool Co	56
Fellows Gear Shaper Co	11
Ferracute Machine Co	43
Ferris, Walter	46
Fifield Tool Co	56
Flather & Co	16
Foos Gas Engine Co	54
Frick Co	54
Garvin Machine Co., The	52
General Electric Co., The	55
Geometric Drill Co	9
Gisholt Machine Co	3
Gleason Tool Co	56
Goodell-Pratt Co	46
Goodyear, S. W	4
Gould & Eberhardt	16
Grant Gear Works	16
Gray Co., G. A	16
Hamilton Machine Tool Co	55
Hammacher, Schlemmer & Co	39
Hampden Corundum Wheel Co	4
Harrington, Son & Co., Edwin	50
Hart Mfg. Co	1
Hartford Steam Boiler Insp. & Ins. Co	15
Heald & Son, L. S	55
Hendey Mach. Co	13
Hill, Clarke & Co	14
Hoggson & Pettis Mfg. Co	9
Horsburgh & Scott	56
Horton & Son Co., E	9
Howard Iron Works	55
Huggins, Thos. J	14
Hurlbut-Rogers Machine Co	42
Hyatt Roller Bearing Co	2
Ingersoll-Sergeant Drill Co	49
International Correspondence Schools	43
Jenkins Brothers	39
Jones & Lamson Machine Co	16
Kearney & Trecker	52
Kempsmith Machine Tool Co	4
Keuffel & Esser Co	3
Landis Tool Co	43
Le Blond Machine Tool Co., R. K	56
Le Count, Wm. G	9
Leffel & Co., James	54
Leland & Faulconer Mfg. Co	4
Lodge & Shipley Machine Tool Co	45
Long & Allstatter Co	46
Lucas & Gliem	16
McCabe, J. J	14 and 46
Main Belting Co	8
Marshall & Huschart Machinery Co	15 and 41
Mietz & Weiss	54
Montgomery & Co	40
Moore, Merritt	14
Morse Twist Drill & Mach. Co	15
Morse, Williams & Co	4
Morton Mfg. Co	11
Moseley Lathe Co	16
Mossberg & Granville Mfg. Co	40
National Elastic Nut Co	10
Newark Machine Tool Works	16
New Era Iron Works	54
New Haven Mfg. Co	47
New Jersey Machine Works	40
New Process Raw Hide Co	55
New Process Twist Drill Co	46
Newton Machine Tool Works, Inc	11
Nicholson File Co	39
Nicholson & Co., W. H	11
Niles Tool Works Co., Hamilton	45
Niles Tool Works Co., New York	14
Norton Emery Wheel Co	49
Oesterlein Machine Co., The	16
Oster Mfg. Co	4
Pearson Machine Co	4
Pease & Co., J. F., Ltd	15
Phosphor Bronze Smelting Co., Ltd	46
Pierce Engine Co	54
Pond Machine Tool Co	47
Pond Machine Co., L. W	42
Potter & Johnston Co	8
Pratt & Whitney Co	3
Pratt Chuck Co	9
Prentiss Tool & Supply Co	14
Putnam Machine Works	16
Q & C Co	10
Quint, A. D	46
Reeves Pulley Co	43
Reinecker, J. E	13
Reliance Machine & Tool Co	42
Rogers Boat, Gage & Drill Works, John	50
Rue Mfg. Co	49
Safety Emery Wheel Co	15
Saunders' Sons, D	46
Sawyer Tool Co	40
Sebastian Lathe Co	2
Sellers & Co., Inc., William	16
Seneca Falls Mfg. Co	4
Shocknessy, Thos	14
Shultz Belting Co	16
Sibley & Ware	49
Siemens & Halske Electric Co	2
Silk, Anderson Co	48
Sittman & Pitt	42
Skinner Chuck Co	9
Slocomb & Co., J. T	49
Smith & Mills	43
Snyder, J. E	2
Soller, E	15
Spencer Auto. Mach. Screw Co	46
Springfield Foundry Co	55
Springfield Gas Engine Co	54
Springfield Machine Tool Co	53
Springfield Separator Co	2
Standard Tool Co	48
Starrett Co., L. S	10
Steel Ball Co	7
Stevens Arms & Tool Co., J	8
Stover Novelty Works	4
Stuart's Foundry & Machine Works, R. J	56
Syracuse Twist Drill Co	44
Tabor Mfg. Co	39
Tight Joint Co	6
Toomey, Frank	14
Towsley Mfg. Co., J. T	6
Trump Brothers' Machine Co	9
Turner, Vaughn & Taylor Co	8
United States Metallic Packing Co	42
Veeder Mfg. Co	52
Warner & Swasey	56
Watson-Stillman Co., The	52
Weber Gas & Gasoline Engine Co	54
Webster Mfg. Co	54
Wells Bros. & Co	56
Westcott Chuck Co	9
Whitcomb Mfg. Co	14
Whitney, Baxter D	2
Whitney Mfg. Co	50
Whiton Machine Co., D. E	47
Wiley & Russell Mfg. Co	48
Wiley & Sons, John	39
Williams & Co., J. H	48
Windsor Machine Co	5
Winkley, F. D	16
Wood's Sons, T. B	46
Woodward & Powell Planer Co	39
Woodward & Rogers	9
Worcester Machine Screw Co	11
Wyke & Co., J	8
Wyman & Gordon	56
York Co., S. M	14
Young Mfg. Co., W. C	49

Contents.

	PAGE
Hoisting Engine Development	17
A Design Stealer's Trick	18
Technical Publications	18
Commercial Review	19
The Tamarack Mining Company's New Hoisting Engine—I	21
Mechanics, Their Relation to Each Other and to Mechanical Industries —Trade Schools	26
The Octoid System of Gear Teeth	29
A Locomotive with a Corrugated Furnace	29
A Peculiar Accident	29
The Premium Plan at the Works of A. L. Ide & Sons. By Herman Fernstrom	30
Making a Compound Watch-Wheel Die. By Lundvall and Klute	33
Letters from Practical Men: Quick Sketches of Tools. By D. E. MacCarthy....Piece Work Versus the Premium Plan. By Dulcet.... Punching and Shearing Small Spring Steel. By C. E. Quimby	34-37
The Columbus Meeting of the Society for the Promotion of Engineering Education	37
Personal	39
Obituary	39

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 22 NEW YORK, THURSDAY, SEPTEMBER 7, 1899 NUMBER 36

Published at 218 William St., New York,
Every Thursday by the

American Machinist Press.

[INCORPORATED.]

JOHN A. HILL, President and Treasurer.
A. LEIGHTON DONNELL, Sec'y.

Editorial Department.

FRED J. MILLER, Chief.

FRANK RICHARDS,
F. A. HALSEY,
EDWARD P. BUFFET, } Associate Editors.

Representatives of Business Department.

ANGUS BALLARD, for New England.
JOHN MCGHIE, for Middle States.
WILLIAM R. WALLIS, for the West.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$3 per year in advance, postage paid in North America.
$4 per year in foreign countries, postage prepaid.
No back Numbers beyond current year.
For Sale by Newsdealers, generally.

CHAS. CHURCHILL & CO.,
9 to 15 Leonard St., Finsbury, London,
Agents for Great Britain.

FENWICK FRERES & CO.,
21 Rue Martel, Paris,
Representative for France, Belgium, Switzerland and Italy.

V. LOWENER,
Copenhagen,
Representative for Denmark, Norway and Sweden.

Entered at New York P. O. as second-class mail matter.

Cable address, "MACHINIST," N. Y.
A. B. C. Code.

Hoisting Engine Development.

Few of the American people—none, in fact, except those who have been there—have any adequate idea of the magnificent display of machinery to be seen in the iron and copper mining regions of Northern Michigan. Were the sights to be seen in that section generally known, it would become a resort for sightseers from all portions of the country. Engineers and mechanics especially would not consider that they had done their duty by themselves until they had feasted their eyes on the great works in steel and iron which there abound. Nowhere else on this continent is there anything so impressive, while the machinery exhibit at the World's Fair at Chicago was tame in comparison. These are large statements, but will scarcely be disputed by anyone who has been there.

The great hoisting engine of the Tamarack Mining Company, particulars of which are given elsewhere in this issue, suggests a few reflections on the development of hoisting engines in the Lake Superior region, than which there are few more interesting topics.

In the early days of mining in any section, the hoisting-engine problem is a simple one; and, indeed, so far as metal mining is concerned, the problem never became a large one until the advent of the power drill. In those days it was not a question of how much material could be hoisted, but of how much could be mined. The depths to be hoisted from were shallow, the output by hand drilling was limited, and the small geared hoist amply sufficed to clear the mine of all the material mined. With the advent of the power drill the quantity mined increased, and, with increasing depths, increased speed of hoisting was necessary to hoist old amounts. This increased speed necessitated abandoning the gearing between the engine and the rope drum shafts, and the direct or first motion hoist with the engine cranks keyed to the drum shaft came in. The effect of this was far-reaching. The speed of the engine being reduced to that of the drum, its size was necessarily increased, and since the change was made in order to do faster hoisting, the horse-power required was increased at the same time. As depths increased, this condition was intensified, and gradually the power required, which before had been insignificant, became a considerable factor in the total cost of mining. In the effort to reduce this and at the same time increase the output, the balanced hoist appeared, in which the descending empty bucket balanced the weight of its ascending loaded mate, leaving the ore alone as the net load to be hoisted by the engine, and at the same time nearly doubling the output of the hoist by avoiding the loss of time in lowering the skip for a new load. This form of hoist, however, required larger shafts for the two skip ways, and on account of this, in the early days of balanced hoists, the balancing was in some cases effected by a balance bob or dead weight running down a separate and otherwise abandoned shaft. The results obtained from such makeshift outfits as this furnished the evidence necessary to convince many mining men of the superior economy of balanced hoists.

Meanwhile the inclined shaft following the ore vein, with its "skip" or bucket running on a track, which always prevails in the early days of mining in any section, was being abandoned for the vertical shaft with its cage and separate car—the "cage," as some of our readers may need to be informed, being essentially a warehouse elevator. Many reasons led to this change, chief of which was the ever-present necessity for increasing the output. With the inclined shaft and its skip attached to the rope, the engine must stand still while the skip is being loaded; while with the cage and separate car the engine need be idle long enough only to push off the empty car and push on the full one. In addition to this, the cage hoisted vertically and fitted with guides embracing the guide rails, may clearly be hoisted safely at a speed far in excess of what is practicable with a skip with wheels running on an inclined track. The change, however, reacted on the engine, partly by reason of the increased power required by the increased speed, and partly because the cage construction increased the non-paying load. The increase of non-paying load had no effect on the power required, since the cages balance each other, no matter what their weight may be, but it added to the difficulty of securing a perfect balance through the increased size of rope involved, and this came at a time when the weight of the rope was already becoming a complicating factor in the balancing. It will be observed that, with the load at the bottom of the shaft, the weight of the rope is added to that of the load at the end of it, while with the load at the surface, the rope disappears as part of the load to be hoisted. Hence with cylindrical drums, cages which are balanced when both are half-way down the shaft, are not balanced at any other point. The larger the rope the more pronounced this action, since, whatever its size, it all acts as weight to be hoisted when run out, and all disappears when run in. Hence the adoption of the cage, by adding to the size of the rope, intensified the difficulty of perfect balancing.

This point of the weight of the rope is of more importance than would be supposed by anyone who has not given attention to it. With the present hoist, the weight of one rope is 21,800 pounds, while the total load, including the rope is but 42,000 pounds—the rope being thus more than half the total. With a loaded cage starting from the bottom, the pull on that side would be 42,000 pounds, while the balancing load of cage and empty cars—the light cage being at the surface with the rope wound on the drum—would be but 8,200 pounds, giving a net load to be hoisted of 33,800 pounds. With the loaded cage at the surface these conditions are

reversed, the load on that side being but 20,200, while the load on the "light" side has had the weight of the rope added to it and becomes 30,000 pounds, which is much the greater of the two. In other words, starting with the loaded cage at the bottom of the shaft, and with a net load to be hoisted of 33,800 pounds, this gradually lessens as the load rises, eventually disappearing and being finally succeeded by a reversal of the conditions, the empty cage and rope doing the work and the landing being effected by the brake. This condition of things is highly dangerous and altogether intolerable, and to meet it the conical drum was introduced, in which the rope, when fully wound up, acts on the large radius of the drum, and when paid out on the small radius—the variation in leverage counteracting the variation in weight of the rope hanging from the drum.

Another device for meeting this difficulty is the flat rope of tapering section and wound upon a reel instead of a drum. The tapering section reduces the weight of the rope, and the rope winding on itself gives to the reel an action similar to that of the conical drum. The flat rope, however, has never been looked upon with favor in the Lake Superior region, the chief reason being that, unlike the straight rope, it cannot be reversed to equalize wear. Moreover, the arrangement is inflexible at best, as the large and small diameters of the reel are determined by the thickness and number of wraps of the rope, and may not be such as to suit other requirements.

During all this development, the size of the engines was being constantly increased and the problem of handling them became a serious one. Hoisting engines, of all engines in the world, must be under absolute and easy control. They must be started, stopped and reversed with the utmost ease and precision. With the growth in the size of the engines until the mere brake shoes, for example, came to weigh tons, with other tons of pressure necessary to make them hold their engines, manual power became entirely inadequate to manage them, and steam cylinders controlled by hand-operated valves were introduced to operate the brakes, the reversing gear, and finally, in this instance, even the throttle valve.

Meanwhile the constantly increasing speed of hoisting—reaching in the present instance three-fourths of a mile a minute—had added to the dangers of overwinding. Although indicator gears for showing the exact position of the load at all times were long ago added, they are not a sure preventive of accidents from this cause. Through disarrangement of the indicator gear or loss of control at critical moments, cases have arisen in which the loaded skip or cage has been shot through the top of the shaft-house, with widespread ruin and loss of life as the result. This has even happened when loads of miners were being hoisted to the surface, and with appalling results. These dangers have rendered necessary the addition of safety stops, whereby the engine shuts off its own steam and applies its own brakes in case of failure to do so by the attendant. In the Tamarack hoist an additional safety feature has been introduced whereby the brakes are normally set, the action of the operator being to release rather than to apply them, as in common practice. The result is that with steam down and the engine room deserted, the engine is locked in position and cannot be turned over until steam is raised and the brakes released.

These explanations will serve to show the reasons for the highly organized character of the modern mine hoist, of which this machine is a splendid example. The fact is, there is no department of engineering which has called for a higher degree of talent, either from the standpoint of design proper or of ingenuity of invention, than that of mine hoisting machinery, and those whose field of work is far removed from that of this class, and who too frequently regard mining machinery as of a rough and ready character only, ought to acquire added respect for it and for those who devote themselves to it, from this example of Mr. Nordberg's work.

A Design Stealer's Trick.

Though we all know that the habitual design stealer will stoop to almost anything, few perhaps would be prepared to believe what we have recently found one of them to be guilty of.

He ordered from a New England builder a special machine adapted to his own work, and when it arrived at his place, took it to pieces, made drawings of it (and possibly castings from its parts), put it together again and returned it to its builder as "unsatisfactory." Then he built several of the machines from the stolen drawings (for, of course, it was the same as stealing them), and had the effrontery to catalog the machine as one of his own products.

Up to date, this beats anything we have heard of in that line. The stealer usually pays for, at least, one machine.

Technical Publications.

"Note Taking, Dimensioning and Lettering." By F. N. Willson. 33 10x12-inch pages, with numerous illustrations and alphabets. The Macmillan Company. Price, $1.25.

This book is made up from the plates for the author's larger work, "Practical Engineering, Drawing and Third Angle Projection," which was recently noticed in these columns. It has the same features of fine paper, printing and engraving that characterizes the larger book from which it is taken.

"Modern Plumbing, Steam and Hot Water Heating." By Jas. L. Lawler. 397 7¼x10-inch pages, with 284 illustrations. The Chiswick Publishing Company. Price, $5.

From the practical mechanic's standpoint this is one of the best books which we have recently examined. Its scope is well shown by its title, and every page shows the author's complete familiarity with his subject. The book can be unreservedly recommended, not only to those who follow the line of work covered by it, but to all who desire correct information regarding domestic engineering.

"Compound Engines." By James Tribe. 137 4½x6½-inch pages, with numerous illustrations. Published by the author. Price, $1.50.

This book is based upon a series of articles published in the "American Machinist" in 1891. Modifications and additions have been made, but the general character of the work is not changed. Double, triple and quadruple expansion engines are treated with especial reference to the proportions of the cylinders to the load, the steam pressure and each other. The mathematical work is reduced to its simplest elements, and as a designer's and constructor's manual the book is of the most useful character.

"A Practical Course in Mechanical Drawing." By William Fox and C. W. Thomas. 98 5½x7¾-inch pages, with 87 illustrations. D. Van Nostrand Company. Price, $1.25.

This is a book of very practical and common-sense character. Ornamental adjuncts of shading, tinting, fancy lettering, etc., are avoided, the tendency toward exhibition work of this character being condemned. Working drawings only are treated, and the examples given of such drawings are in the main excellent. There is no exhibition of finely made examples of the engraver's art, the illustrations being intended to show what an average draftsman should be able to accomplish. Several of the illustrations are in fact obviously photographic reproductions of free-hand sketches. The student of this book will acquire from it no false notions of mechanical drawing as an "art," but, so far as it carries him, will learn to make drawings as they are really made.

A velocity of 140 miles an hour is recorded for the wind at Cape Hatteras on August 17. At the speed mentioned the anemometer cups blew off.

It is proposed to have the machinists at the Washington Navy Gun Shop wear numbered badges, and the men resent this and threaten to strike. Such badges are not necessary and are likely to do more harm than good.

Commercial Review.

NEW YORK, FRIDAY EVENING,
September 1, 1899.

MACHINE TOOLS.

If this year's and other years' trade were plotted out in curves, the abscissas representing time and the ordinates activity of demand, we should not only see that the 1899 curve kept above those for the previous five years throughout its entire length up to September 1, but we should expect to see that it was a straighter line, and that instead of the pronounced dips corresponding to the months of August and September, there was not more than a trifling depression. This graphic statement of the commercial situation the reports that reach us tend, upon the average, to confirm.

Few advances in prices of machine tools in the month of August have come to notice, and it looks as if a halt, temporary at least, has been called in the upward movement.

Despite the general advances in prices of machine tools in the past year or so, it is a fact that certain of the largest and most widely known companies in the East have made practically no change. The reason in one case seems to be that the company is a "one-price" concern, priding itself upon making neither concessions in dull days nor advances in prosperous ones. In another instance the circumstance seems to be partly because the company adheres to historic forms of tools, upon which it gained high reputation many years ago, and that its prices are rather high for the present day. A third company which has throughout the year adhered pretty closely to old figures, made an advance on some lines in August, amounting to 5 per cent.

The Seneca Falls Manufacturing Company has advanced prices on its lathes 10 per cent.

Bardons & Oliver in the past month have slightly advanced the prices of a good proportion of their screw machines.

While touching upon the subject of prices of machine tools it may be mentioned that within a few days past one of the chief American engine manufacturers has made material advances in the prices of certain large sizes of engines. These prices had not hitherto been advanced as much as those of some other sizes. The company predicts a further advance, and it is not a concern which would make an idle boast.

Deliveries are somewhat easier in some directions. A purchasing agent who does an extensive business with many companies, says that he can now obtain most kinds of small tools rather more readily than earlier in the year, while heavy tools and planers, whether large or small, show little or no relief.

The Garvin Machine Company has placed orders for $25,000 or $30,000 worth of machine tools, which will be used in the equipment of the new factory to be erected in Germany by the company which has succeeded to the Garvins' Berlin branch. It will be remembered that we announced in connection with the report of the organization of this concern that the Garvin Machine Company had a contract to supply their equipment. The subcontracts let by the Garvins, noted, call for delivery of the machinery in February. We understand, however, that the manufacturers have some of it ready to ship right away if it could be received. Notable among these sub-contracts was one made with the Hamilton Machine Tool Company for lathes, drills and radial drills, and one for Flather planers. Other portions of the tool equipment, including small supplies, are yet to be ordered. The projected factory is described as an American shop transplanted into Germany.

A number of notably large tools sold by Bement, Miles & Co. through their Berlin agents are now going abroad. This week a 79-inch locomotive driving wheel lathe was being shipped as the last of a series of tools which have gone hence to a new locomotive works in Finland. A still larger lathe of the same make has been ordered for another part of Europe. A 14 to 20 foot extension vertical boring mill will go to Sweden this month; a 10 to 16 foot boring mill for Europe has been ordered, and a 10-foot one was shipped last Saturday to Germany.

In conversation with a machine tool seller, who has figured prominently in this market for many years past, upon the prospects of the Niles-Bement-Pond Company, the following view of the situation was developed:

The consolidation places the merged companies in an excellent commercial position and should enable them to obtain decidedly more business as a unit than they would have gotten severally. This arises largely from their ability to figure upon complete equipments of large plants. Where a railroad or other corporation which has occasion to install a large machine shop can satisfactorily meet its requirements through one tool house the transaction can be conducted on a more economical basis than where the contract is split up. In work of large character, heavy tools are apt to be a very important consideration, and hence a company which can get control of the situation in those lines by being prepared to meet all requirements for heavy machines better than its competitors will gain a prestige which will facilitate the sale of the smaller lines which it handles in connection with its own larger ones. The Niles-Bement-Pond Company has a bright future before it, if its business is discreetly managed. The speaker was somewhat apprehensive, however, that the company will avail itself of the economic position it has attained to advance prices, an action which would be of questionable policy, he thought, unless the justification therefor in higher cost of material were given strong emphasis.

No recent advance has, in fact, been made in the tools now controlled by the Niles-Bement-Pond Company, it is stated, barring a slight stiffening on some heavy machines as a result of costlier material.

Four weeks ago a machine tool manufacturer's agent in this city was figuring on tools to go into about five new automobile factory equipments. It was reported yesterday that the same five contracts were still pending.

The Lodge & Shipley Machine Tool Company was stated the other day to have on hand orders for 350 lathes.

The August business of the Pratt & Whitney Company in this market was the best for any month of the year, though this may be due to other reasone than state of general demand. Tools of the company which found an active market included wire feed, automatic and magazine automatic screw machines, multiple spindle drills and large milling machines. There was a great increase in orders for tool-makers' lathes and small tool sales were heavy.

Within some three months past the New York Shipbuilding Company, whose yards are at Camden, N. J., has placed orders with one machine tool store in Philadelphia of $40,000. It placed other good orders, one being with a Cincinnati tool manufacturing company. We have recently referred to the fact that the company is still in the market for equipment of various kinds.

The best local authority we know of upon the European, particularly German, market pronounces the August trade as having been most excellent.

The store which Schuchardt & Schütte are erecting in St. Petersburg will soon be occupied, probably this month. The company has done a good deal of business in Russia through its Berlin headquarters, but the establishment of this new branch is expected to augment it considerably.

MISCELLANEOUS.

The Iola Portland Cement Company, Iola, Kan., has ordered for general power purposes twelve Westinghouse gas engines, aggregating 3,000 horse-power; natural gas will be used. This is stated to be the largest order for gas engines ever let in this country. The next largest is said to be the 1,100 horse-power equipment of a lighting plant in Columbus, Ohio, where engines of the same make are used.

The Westinghouse, Church, Kerr Company has just made arrangements to act as engineers, architects and contractors for the installation and equipment of the Toledo (Ohio), Fremont & Norwalk electric railroad, a long inter-urban line. A central power house will be located at Fremont, and there will be seven rotary transformer sub-stations. Westinghouse engines and electrical machinery will be em-

ployed, and Roney stokers. As to the boiler plant and other details of the installation it is too early to speak.

The same engineering company is now constructing the plant of the Rapid Railway, a 65-mile electric line extending from Detroit, Mich., to Port Huron.

PITTSBURGH REPORT.

It is an extremely hard matter for anyone to keep a complete record of the iron and steel markets for the past month or two. Never in the history of the country have affairs been in such a shape as they are at present. No one seems to be able to get all the iron they want, and manufacturers, while pushed to their greatest capacity, are not in a position to quote prices for iron to be delivered this year. One of the largest iron producing concerns in the country state that they have already on their books for delivery in 1900 orders amounting to over 400,000 tons. These orders were taken at advanced prices, and really show the exact condition of the market. It was the thing not long ago to fill up with iron because it was cheap, but at the present time they want it because they must have it, irrespective of prices. In reference to iron prices it might be said that advances are made almost daily. A representative of a large Southern concern announced an advance of 50 cents a ton on all grades of iron, taking effect September 1. It may be that before many hours roll along that another advance will be made known.

It is absolutely known that the first three months of next year will be needed to take over the hold-over business of 1899, but the second quarter's business is new work. The demand for raw material is so widespread that no attempt is made to locate or individualize it, and each day has some additions to the total. There is no prospect that the highest limit of production will overtake the business classified as immediate.

As far as contemplated industries are concerned, there are many that have been held back on account of the scarcity of structural material and the extreme high prices ruling same. Only during the last week of August the price was pushed up $5 per ton. It is a fact, however, that the price of this commodity was too low in comparison with Bessemer steel, and the new price was looked for by many.

Among the many new concerns who are in a position to get building material may be mentioned the Baker Forge Company, Allegheny, Pa., which has in contemplation the erection of a new plant at Rankin, near Pittsburgh, for the manufacture of heavy wagon iron, chain, etc. Mr. Armin Schotte, a well-known engineer of Pittsburgh, is preparing plans for the works, which will consist of a main building 80x360 feet, winding and cutting department 80x60 feet, and a power house 50x80 feet. The power will be furnished by gas engines, for which no contracts have been awarded. The company will also need pumps, blowers, forges, etc. The new cold rolled shafting plant at Rankin to be built by a party named Fitch, of Braddock, will be erected as soon as all the plans have been completed. The Riter-Conley Company has been given contracts for the steel work on the furnace plant of the American Steel and Wire Company, in Allegheny. This stack will be one of the largest in the country, and will equal the output of the Duquesne furnaces of the Carnegie Steel Company.

CHICAGO MACHINERY MARKET.

August has been almost as lavish in her favors to the Western machine trade as was July. One or two sellers report trade dull, but with most of them the marvelous activity of the earlier part of the summer was maintained through August, with varying shades of comparison, some houses finding in July the climax of the summer's trade, others reaping the greater business during the month just closed. With one seller, the Marshall & Huschart Machinery Company, August went out with pyrotechnics, the sales of the final day of the month—some of them by wire—sending totals in dollars and cents some 15 per cent. above previous records. It was a promising prelude to the fall campaign.

The doubling of shop capacities at almost all kinds of factories has been the secret of this phenomenal summer trade. In three distinct lines, namely, iron and steel implements and electrical goods, there has been most notable activity through the summer months. The crowded condition of work at the mills, furnaces, foundries, boiler shops and similar manufactories of iron and steel has shown no abatement. Implement works have been branching out to the same extent. Electrical companies are enjoying unprecedented prosperity. The Western Electric Company, the Sterling Electric Company, the Kellogg Switch Board and Supply Company, and many other electrical machinery builders have doubled the capacity of their works and have added machinery accordingly. The automobile industry continues to hold first rank in the minds of machinery sellers as a coming market. The railroad shops are picking up a few tools, but are not very earnest buyers of improved equipment. The bicycle works are modest beyond the measure of recent years. A few manufactories of various kinds are being fitted out with machinery, but they take only a small percentage of the tools that are being sold.

Turning from buyer to maker of tools, the complement of this activity is beheld. There is scarcely a large seller of tools in Chicago who has not booked orders for delivery next year. One house has sold a large planer to be shipped next June. The tool could have been delivered in March, but the buyer was farther sighted than most recent purchasers, the rule being that machine tools are wanted at once or before deliveries can be made. From four to six months is now the average length of promised delivery for large tools, smaller machinery being deliverable earlier. Prices are slowly and irregularly advancing.

Hill, Clarke & Co. have just fitted out a new ship repair plant with a tool equipment, inchuding two $2,000 machines and a large number of smaller ones.

Among recent sales of J. B. Doan & Co. were a variety of tools for the Olds Motor Works, of Detroit, a new company organized to build automobiles.

A lathe manufacturer in Cincinnati is said to have exported during the month of August as many as 110 lathes. The company in question is receiving better demand for lathes from abroad than from home.

Quotations.

NEW YORK, TUESDAY MORNING,
September 5.

Iron—American Pig, tidewater delivery:—

Pennsylvania irons:

No. 1 X foundry	$21 60 @ $23 00
No. 2 X foundry	21 10 @ 22 00
No. 2 plain	20 60 @ 21 00

Alabama irons for delivery in 1900:

No. 1 foundry	21 50 @ 22 00
No. 2 foundry	20 50 @ 21 00
No. 3 foundry	19 75 @ 20 25
No. 1 soft	21 50 @ 22 00
No. 2 soft	20 50 @ 21 00
Foundry forge	19 75 @ 20 25

Bar Iron—Base sizes—Refined, mill price on dock, 2.25 @ 2.30c.; store price, 2.50c., upward; common, from store, 2.40 @ 2.50c.

Tool Steel—Base sizes—Standard quality, 6½ @ 7½c.; extra grades, 12 @ 14c.; special grades, 16c., and upward.

Machinery Steel—Base sizes—Ordinary brands, from store, in small lots, 2.70c.

Cold Rolled Steel Shafting—Base sizes—From store in small lots, 3¾c. As a result of advanced prices that have been made by mills, it is said that in a few days 3.87½c. will probably be asked from store.

Copper—Carload lots, Lake Superior ingot, 18½c.; electrolytic, 17⅝ @ 17¾c.; casting copper, 17⅜ @ 17½c.

Pig Lead—Carload lots, 4.62½ @ 4.65c., spot, New York.

Pig Tin—In 5 and 10 ton lots, f. o. b., New York, 31¾ @ 32c. At time of going to press to-day it is rather early for a definite market.

Spelter—Prime Western in carload lots, 5.55 @ 5.65c., covering early shipments and spot.

Antimony—In cask lots and over, Cookson's, 11c.; Hallett's, 9¾ @ 9⅞c

Lard Oil—Prime, present make, ice pressed, 44 @ 45c., in wholesale lots for the leading city brand, but some prime lard oil may be had for at least 3c. less.

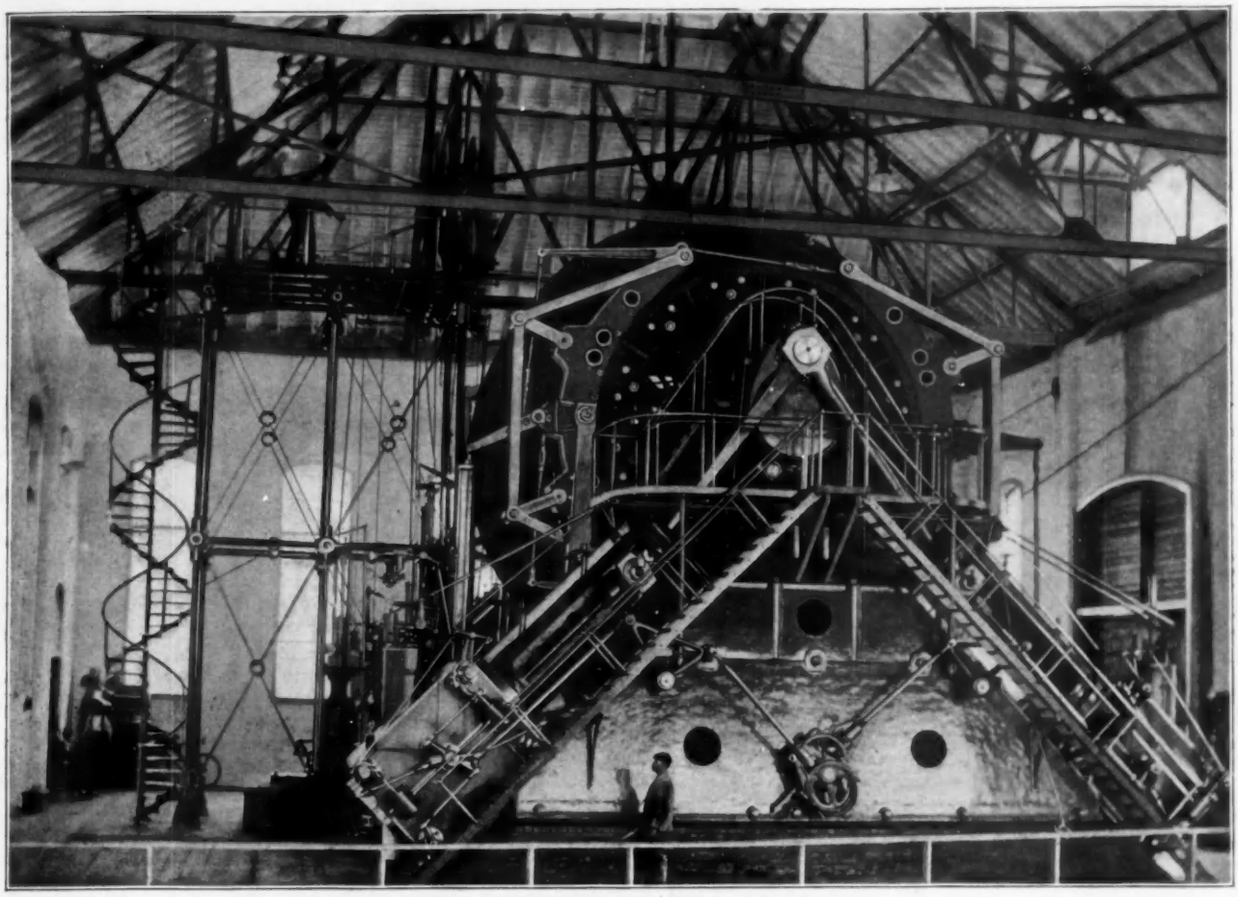


FIG. 1. THE HOIST IN POSITION FOR WORK.

The Tamarack Mining Company's New Hoisting Engine—I.

This engine, which has recently been set at work, was constructed by the Nordberg Manufacturing Company, of Milwaukee, Wis., from designs by Mr. Bruno V. Nordberg, chief of the engineering department. The engine is of magnificent proportions, and is shown in the accompanying half tones and line engravings. Of these Fig. 1 shows the hoist as erected and at work; Figs. 2 and 4 show one side of the engine in process of erection at the shop, Fig. 2 showing more particularly the operator's platform and indicators in correct position with respect to the other parts, and Fig. 4 the reversing and brake gear and the steam cylinders for operating them; Fig. 3 is a side elevation of the machine complete; Fig. 8 illustrates the throttle valve; Fig. 14 is an elevation of the operator's platform, and Fig. 15 is a section of the rope drum. The other figures are diagrammatic illustrations of various features and principles of different parts of the mechanism.

The magnitude of the engine will be appreciated from a few leading dimensions, as follows:

Steam cylinders (of which there are four)—34x60 inches.

Main bearings—24x42 inches.

Crank pins—12x15 inches.

Cross-head pins—6½x12½ inches.

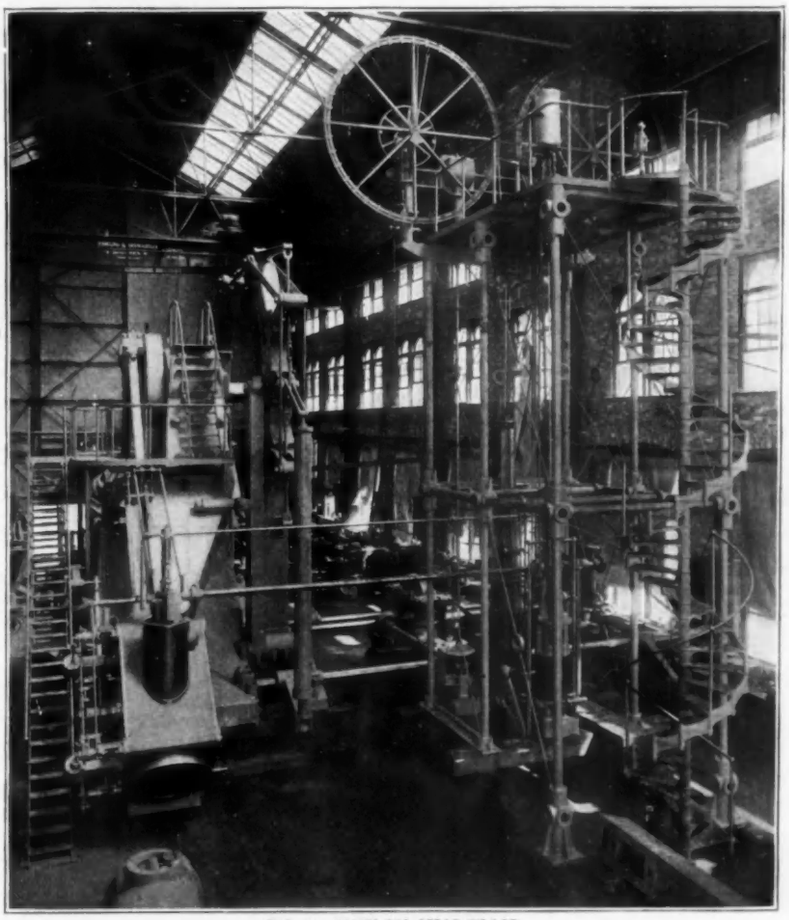


FIG. 2. VIEW ON SHOP FLOOR.

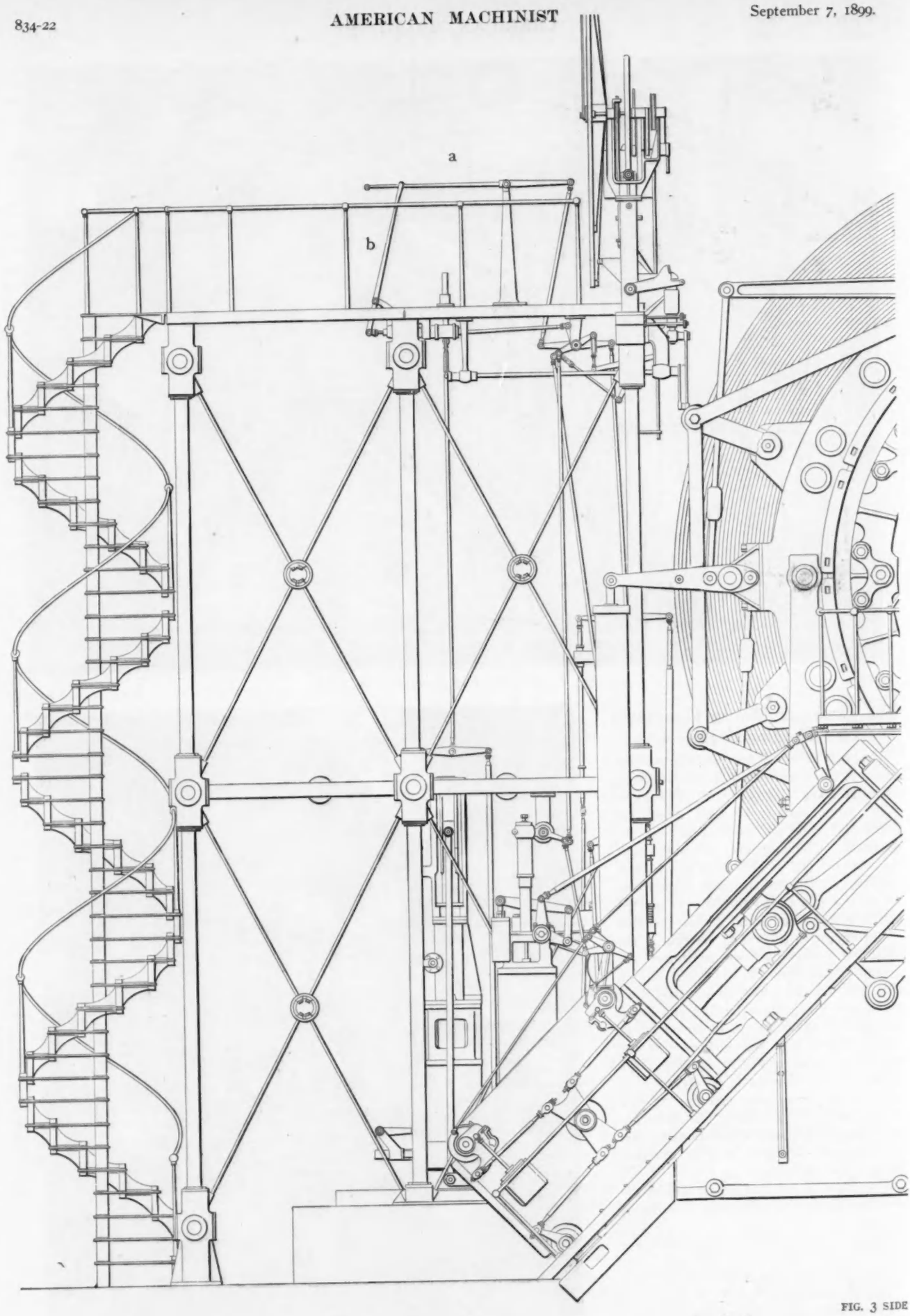
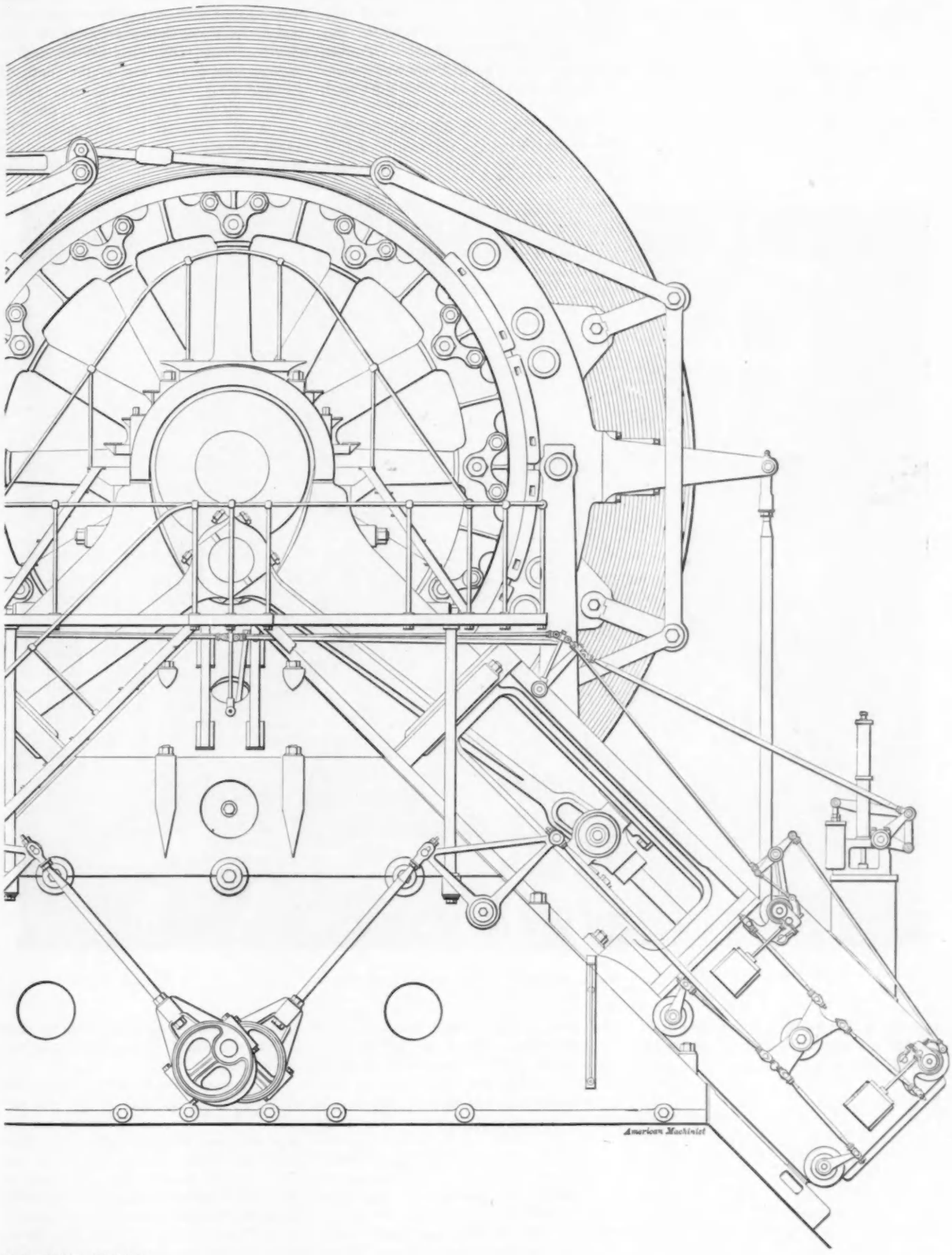


FIG. 3 SIDE



ELEVATION COMPLETE.

Diameter of rope drum—25 feet.

Length of rope drum—24 feet 6 inches.

Capacity of drum—6,000 feet of 1½-inch rope.

Total weight—1,200,000 pounds.

Weight of drum and shaft—300,000 pounds.

The engine is of the direct-acting reversible type, with drum keyed on main shaft. It operates double-decked balanced cages, the rope for the empty cage unwrapping and the cage descending while the other one with loaded cars is being hoisted. It is intended to hoist the load at a speed of 4,000 feet per minute from a depth of 6,000 feet, the load being made up as follows:

	POUNDS.
6,000 feet 1½-inch rope.....	21,800
Cage	4,200
Two cars	4,000
Rock	12,000
Total	42,000

To have adopted true conical drums proportioned for perfect balancing of ropes, cages and cars in all positions would have necessitated two cones on the engine shaft, each one large enough to contain one of the ropes, and the enormous dimensions of such a double-cone drum caused it to be abandoned in favor of one with a cylindrical center portion and conical ends. A sectional view of this drum, showing its construction, is given in Fig. 15, but its general type and advantages will be understood from the sketch Fig. 5.

While such a drum does not produce, even approximately, a constant torque, it possesses several peculiar advantages. The central portion of such a drum is used for both ropes. When the left rope is down in the shaft it rests on the drum at *a*, Fig. 5. The right rope is at that moment wound up, resting at *c*, and covering the portion *c d* of drum. When the right rope is down the left one covers the portion *a b* of drum. The points in center of distances *a b* and *c d* are the centers of hoisting compartments of the mine shaft.

On account of the great depth of the mine the load to be handled by the engine is unusually heavy. This condition called for a different arrangement of steam cylinders from the usual one of a pair of double-acting cylinders coupled to cranks set quartering on the shaft, as this plan would have involved very large steam cylinders. A four-cylinder arrangement was therefore used, consisting of two duplex engines, one at each end of the shaft, of inclined type, the inclination being 45 degrees. As the drawings show, there is one crank common to each pair. The angle between the two cranks is 135 degrees. By this arrangement a very near approximation to constant turning effect is obtained which makes the engine very easily handled.

The engine frames are of the hollow girder type, resting on large cast-iron sub-bases. The frames are joined under centers of main bearings, which are fitted with half shells of cast iron lined with hard babbitt metal. The sub-bases are each cut in three pieces. All bolting between the frames, as well as between the frames and sub-bases, is such that all the iron used in the construction of these parts

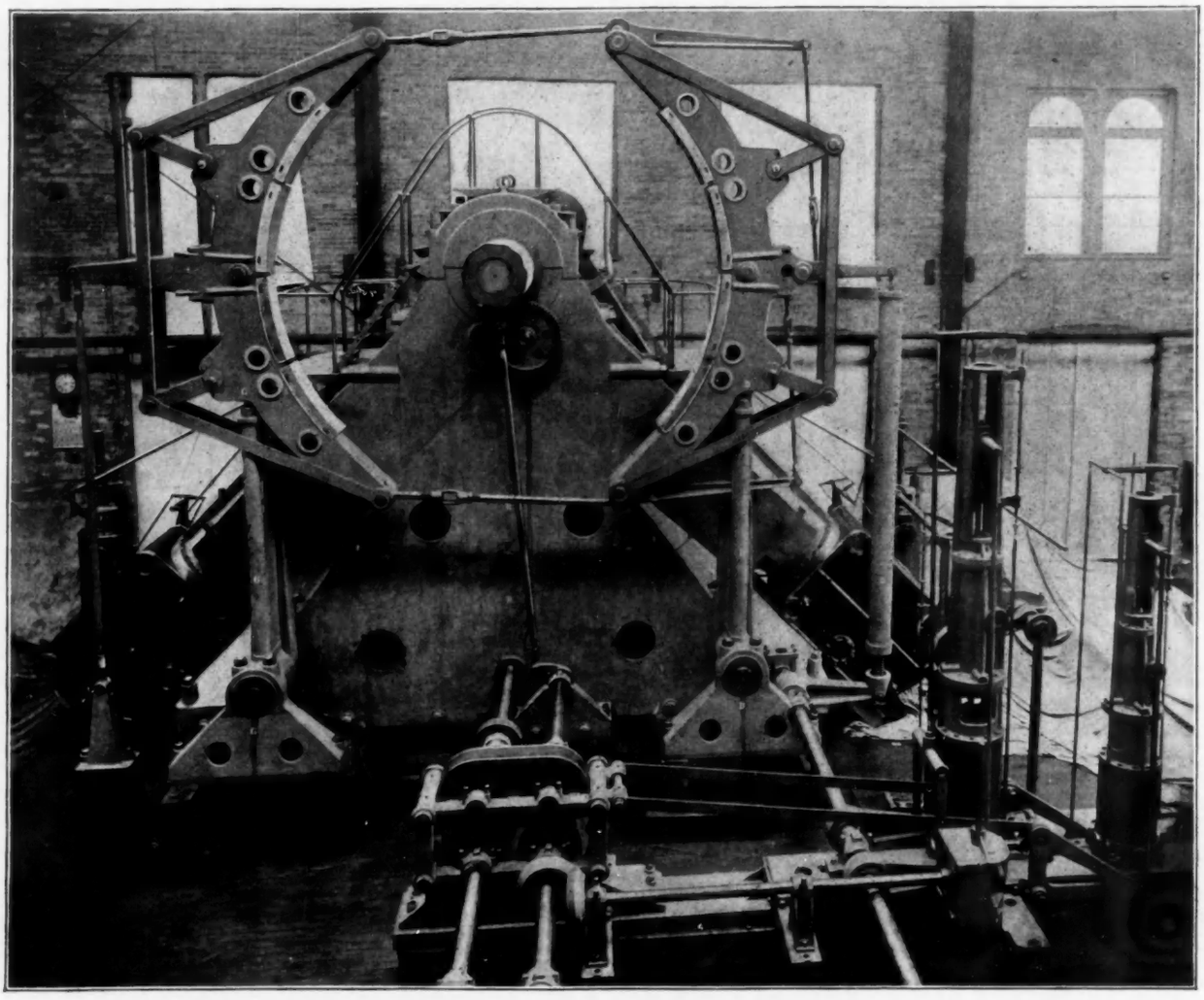


FIG. 4. ONE SIDE AS ERECTED ON SHOP FLOOR.

has to take the strain produced on the bolts, which pass through the entire depth of the castings. Thus the strength of lugs, flanges, etc., is not depended upon, as is often the case in designs of this kind.

The frames and sub-bases are held to

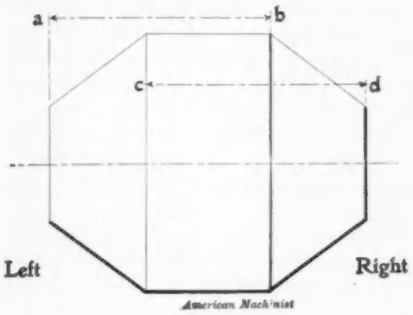


Fig. 5

SKETCH OF ROPE DRUM.

the foundations by means of rods passing through all these parts. Thus the cap bolts are continued clear through the foundation. There are on each frame three diagonal bolts passing through frame, bases and foundation into strong angle-plates under the lower edge of the foundation, which is thus securely bound to the engine resting thereon. The cylinders are steam-jacketed, of the Corliss type, and fitted with Mr. Nordberg's reversing gear. As a Corliss gear requires an exact and invariable amount of the motion on the wrist plates, which cannot be obtained with a link motion, and as four cylinders would also require four link motions, a type of reversing valve gear was adapted in which the eccentrics are advanced with relation to the engine cranks when reversing. The essentials of this gear are shown in Fig. 6, in which A is the engine shaft, on which are keyed the gears $B\,B_1$, meshing into the gears $C\,C_1$. These are provided with crank pins $D\,D_1$, coupled by parallel rods $E\,E_1$ to the cranks $F\,F_1$, which cranks are set at right angles to each other and keyed on the primary valve gear shaft G, which is thus caused to rotate synchronously with the engine shaft. In order to give the gears $C\,C_1$ sufficient rigidity, they are mounted on the ends of shafts reaching through the engine frame, being held therein by means of a sleeve in which the bearings are formed. The holes in the sleeves are slightly eccentric to the outside surfaces—an arrangement which is provided to permit lowering the centers of $C\,C_1$ by turning the sleeves in case of the main bearings wearing down. Of course eccentrics on the main shafts connected direct to cranks $F\,F_1$ might have been used, thus avoiding the gears, but the plan shown was considered preferable because, with such large eccentrics as would have been necessary, more play would have been required than with the small crank pins actually used, and it was feared that this would introduce troublesome irregularities in the transmission.

From G the motion is transmitted to the secondary valve gear shaft I through the gears $H\,H_1\,H_2\,H_3$. This shaft I carries the eccentrics $J\,J_1$, one eccentric being provided for the valves of each cylinder. The gears H and H_3 are equal. The gears H_1 and H_2 are also equal, but enough larger in diameter than H and H_3 to clear each other. The gears $H_1\,H_2$ are mounted on a frame K, Fig. 7, which is held on carriers $L\,L_1$. The figure $M\,M_1\,N_1\,N$ forms a parallelogram, the sides $M\,N$ and $M_1\,N_1$ being parallel to the lines connecting centers of gears. By shifting the position of frame K, so that its centers pass over the arc indicated, the shaft I is rotated through an angle equal to 180 degrees minus twice the angle of advance, whereby the eccentrics are set for either direction of motion. The reversing is performed by a steam device O, Fig. 6, with floating lever connecting the piston rod, steam valve and hand lever, so as to cause the motion of the piston to follow that of the hand lever.

An oil cylinder for checking and steadying the motion is provided with a by-pass valve connecting the two ends. This valve opens and closes simultaneously with the steam valve, to which it is connected, thus locking the reversing gear when hand lever and reversing gear piston are in corresponding position. The shaft I extends through the sub-bases, and the eccentrics $J\,J_1$ are located outside the engines, as shown in Figs. 1 and 4. The appearance and location of these gears and shafts, together with the steam device for operating them, are shown in Fig. 2.

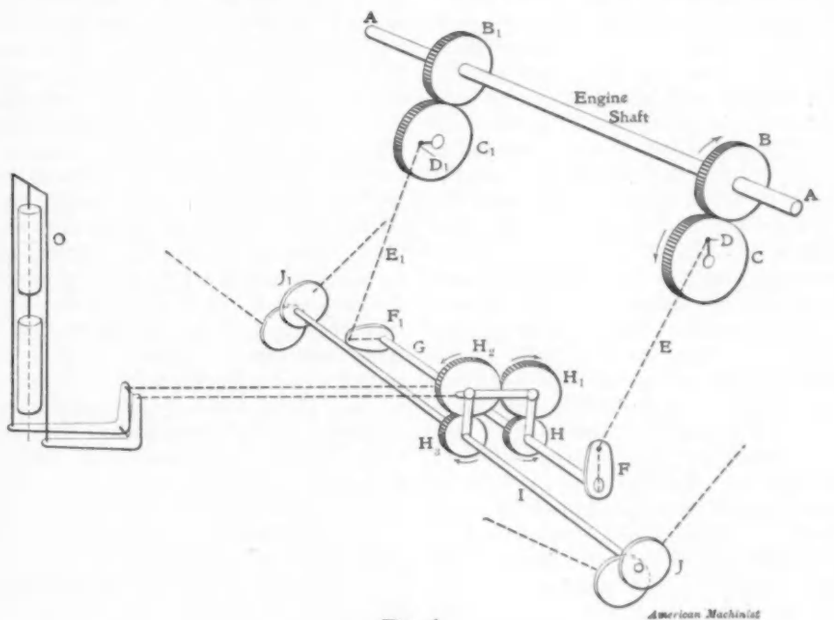


Fig. 6

SKETCH OF REVERSE GEAR.

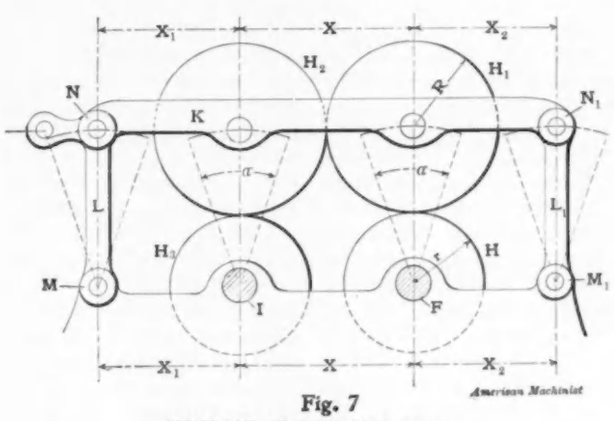


Fig. 7

PRINCIPLE OF REVERSING GEAR.

In at least one of the shipyards of Great Britain ships of the largest size are now being built under cover instead of in the open. Enormous iron sheds are built over the slips, with traveling cranes suspended from the roof trusses. The chief object of the arrangement is protection of the workmen from the weather, and the results show a decided gain both in time and cost of shipbuilding.

Mechanics, their Relation to Each Other and to Mechanical Industries—Trade Schools.

Some time ago Prof. John E. Sweet, of Syracuse, delivered an address before an audience of mechanics and manufacturers in Rochester, N. Y., and from this address we take the following excerpts. He said:

"I appear before you this evening with a certain degree of satisfaction and a certain degree of reluctance. With satisfaction because it is always a pleasure to talk over one's life experience and notions among those who have themselves had both experience and notions, and I came here with reluctance because you are likely to expect more of one who comes so far than you are of one another. While I have had some experience in talking to students, this addressing people on a subject about which they are likely to know more than myself, is rather new, and one can no more make a speech (unless he is endowed with a gift for it) without experience than a boy can use a chipping chisel, drive a shoe peg or shove a jack-plane, until he has learned the trade.

"This learning a trade, or, in other words, the apprenticeship feature of mechanical industries, is a fitting beginning to what I have to say. We have all been or are apprentices, I take it, and when the oldest of us were so favored, the system differed from the present one, and however much we may desire to go back to the good old system, it cannot be done. We old men were all good apprentices. I know I was a real good one, and for no other reason than that I had a first-rate boss. As the boss and I constituted the whole force, aside from the discrepancy in age, knowledge and position, we were chums. When he set me at a job he not only told me what to do, but how to do it, and if there was a reason he told me why. Who could not learn under such circumstances? With our present methods there is no such opportunity. It is not the employers' fault, though the apprentices may think we are rather mean, and if the apprentices of to-day are not very good apprentices it is not their fault; conditions have changed; no one is to blame for it. In the old days there were boys who wanted to learn trades and employers who wanted apprentices, because they could make them pay. They would make good workmen of them in the first years and get a profit out of them in the last. But now employers do not care for apprentices, because it does not pay, and in this there is a simple problem which the parents (who have sons whom they wish to put in as apprentices) do not figure out.

"The apprentice who spends three years in learning a trade, and learns it, gets more for his three years' work, though he work for nothing, than he will get any other three years of his life as a workman. Let him get a dollar and a half a day as a laborer or two and a half at his trade, the difference will be $300 a year, or the interest on $5,000 or $6,000 capital, and the trade is capital he cannot lose.

"In the old days a machine shop could be run at double the men's wages—that is, if the average wages were $1.50, it would pay to charge $3 a day—but that was when building, power and machines cost but little money. With machines costing from $500 to $5,000 to the man, it cannot be done at so low a figure. If the cost of the apprentice is 75 cents a day, and the expense of running the machine is $2.50 a day, the boy's product must sell for $4 in addition to the cost of material, to keep even. If a $2.50 man can do twice as much as a boy his product will at the same rate bring $8, besides cost of material; so on this basis the boy must either do more than half as much as the man, work for less, or the employer cannot afford to have him—in fact, half the time he cannot afford to have him for nothing; and that is not the worst of it. The apprentice often fares worse than the employers; he gets no instruction; he gets a chance to work; he gets a chance to make different pieces of something, but that of only one kind of product, and of the product itself he learns but little. This is one phase of the case, and a rather common one, but there are others. There are yet, even with these conditions, a large number of applicants for apprenticeship positions who cannot get places even at comparatively no pay; and in certain trades where both the boy and master are willing, the trades-union rules, according to their own statement, prevent.

"As shown, the apprenticeship system of old is only in rare cases possible now, and the question must force itself upon our people as to what is to take its place. If limited by the circumstances and the unions our ranks must be filled from abroad or trade schools must be established. I do not mean training schools, which are useful enough in their way, but trade schools pure and simple. Owing to the fact that the opinion is quite universal among mechanics, that a boy cannot learn a trade at school, I wish to define what I mean by a trade school; that is, a school where the object is to give a boy a chance to learn a trade, not a school of school teachers out of college, or school teachers that are graduates of technical schools; not an educational institution with machine shop attachments, but just shops, with machines and foremen and workmen, and work of all kinds going on to be sold for what it will bring. Instead of the chance the old apprentices had, I would have the boy not only have the chance of the old apprentices for doing all kinds of work, but would also give him all kinds of tools to work with, and all kinds of machines to build, which the old apprentices had not; and I would do better by him than that—he need work but eight hours instead of twelve or fourteen, and the rest of the time, after seeing that he knew how to read and write and spell, he should be taught enough drawing and machine-shop mathematics to calculate anything he might need, and enough of the principles of mechanics as would be necessary to keep him from fooling away time on perpetual motion and like impossibilities, and, too, he should be trained to make what he did make a work of art.

"The question will at once come up: Can such a school be made self-supporting? No, it is not at all likely that it can. Some will think, after the shops are built, machine and power put in, that certainly the work turned out ought to sell for as much as the material cost. Yes, it should do this; but there is coal to buy, foremen and instructors to pay; and such a school, excepting by the greatest economy and genius, cannot be self-sustaining. Then the question naturally arises, How is it possible to establish such schools? and the reply is, exactly in the same way that all schools and colleges are established and maintained.

"The State (that is, the people) establishes and maintains schools. Not that it (that is, we) has any moral right to take the money of the rich to pay for the training of the poor, but on the basis of the arrangement that we have adopted a form of government wherein we agree to abide by the will of the majority, so, as the majority say the State shall establish and maintain schools, it has the same right to say that it shall establish and maintain schools to train the poor man's son to be a shoemaker, as it has the rich or poor man's son or daughter to be a scholar, a doctor or a teacher, and it has already established special schools for teachers and doctors. It is true that doctors, while people get sick, and teachers to maintain schools are necessary, so, too, while we live in this climate we must have food and clothing, boots and hats, houses and tools, plows and fuel, and if we die (which we can do even without a doctor), crematories or coffins; and we need to know how to make all of these things before we need to know how to read or to write, spell or cipher, and much more so before we need to study any of the higher branches.

"As all children with present opportunities have the chance to gain the rudiments of an education, the book part of a true trades school needs bear but an insignificant position. I know this sentiment will meet with universal disapproval, but let us argue it to the end. Are not the boys and girls (for the girls are as much entitled to the benefits of a trade as the boys)—are not the boys and girls we are talking about to learn trades to follow through life, and trades at which they expect to make a life business? If so, then what is the education or training that will be of the most use to them? Certainly it

is of far more use to the shoemaker, as a shoemaker, to know the difference between a good piece of leather and a poor one, than to know how to read. It is of far more use to the horseshoer to know how to fit a horseshoe than to know how to spell, and of infinitely more use to the carpenter to know how to file a saw than to know how to write, and yet thousands of our carpenters know how to read, write and spell to every ten who can file a saw decently well, and one defect in their education arises from the fact that they are taught to be proud of the fact that they can read, write and spell, and have passed in arithmetic, grammar and geography, French or Latin, and not to be ashamed of the fact, as they should be, that they cannot file a saw or build a winding stairway.

"I would have the boys and girls who pass through trade schools know both the trade and all of a general knowledge that would do them any good, and I would not have the school spend one cent on them beyond that. If the boy had the ability to become an engineer, or the girl to become a teacher, or either had a desire for a scientific or liberal education, there are now plenty of schools for that without hampering the trade schools. But, you will say, will not all our mechanics and workmen be better mechanics and better workmen, and a great deal better citizens, to have a thorough education? Yes, if educated for his business as I propose. but not if educated through the regular course of our common schools and high schools, technical schools and colleges as now conducted. A thoroughly educated man in the ordinary sense, as a workman, is generally a nuisance to have around, but a man educated to his business, whatever it may be, is an honor to himself and his business, if he sticks to it and behaves himself.

"The shoemaker who can take suitable leather and make an $8 pair of shoes out of it, where the cobbler could only make a pair that would be dear at $3, has a right to be proud of it, and when the scholars spend term upon term to learn to read and write, and speak indifferent French or German, worse than the German or French children, there is not a thing about it to be proud of, and, many times, the training in those directions gone through with by the children in the high schools gives them little to be thankful for.

"The man who is to spend his life as a workman is a poorer workman, a more unhappy man, and more often than otherwise a less desirable citizen, with a liberal or scientific education. With the liberal or scientific education he may get above the necessity of working for a living; but this all cannot do, and those who cannot should be trained to their calling and live happily.

"About the cost of a training school: The entire cost of a plant for the ordinary machine shop, which is by far the most costly of any trade, will vary from $500 to $1,500 for every man employed; certainly I think it will not average over $1,000, and with the others make an average of a cost not to exceed $500 per student or apprentice, with a complete trade-school outfit.

"The absolute money value of our public schools in Syracuse per student is $56, and it is likely to average no less in other cities. The investment at Cornell University is from two to three thousand dollars for each student, besides, likely, there is paid from one hundred to one hundred and fifty thousand dollars a year in tuition fees, or an average of from fifty to seventy-five dollars for each student per annum. If the State would do as much to cover cost of instruction, and our wealthy men do as much to establish trade schools, of which there are none such as I speak of, as they do to establish colleges, of which there are so many, it is plain that it could be done, but it will not be until the people become imbued with the fact that such men as Edison and Bell, Westinghouse and Brush are of more use to this country and the world, are men that we have more reason to be proud of than of Longfellow and Bryant, or Emerson and Holmes, and I believe, from the fact that both Mr. Cornell and Mr. Sibley took so great an interest in the shop part of Sibley College, that had the money been invested in a trade school they would have been quite as well satisfied. The majority of our voting population are men who have to work for a living, and whose sons will have to go to work for a living, and now if they will profit by Herbert Spencer's saying, 'that it is every man's first duty to provide for his own living, and the second to provide for the support of his family,' they will do less grumbling and see that some of the public money is spent to do their children the most good.

"I have taken more time to argue this question than this division of my subject would justify, but am not through with the apprentice and his opportunities yet. The apprentice wants to get all the money he can or get along the fastest he can, and the keynote of this is the keynote of life, whether an apprentice, a workman, a master, a railroad president, a college professor or an author. It is to work, and to work hard, and to do everything one does in as good time as others do, and do the job as well as anyone can, and better than others if he can. And when you come to the money part the question must be not how can I get the most money for what I do, but how can I earn more money?

"It is true that the men who earn money do not always get it, but no more true than that manufacturers do not always get pay for all their product. And this is also equally true of the good apprentice, who is underpaid and is far happier than the idler and slouch, whether over or under paid. The apprentice must remember that he must be a good one or the employer cannot afford to have him around.

"The journeyman, like the apprentice, wants more pay, and there are two ways that he can try and get it. One is to earn it, and the other to strike. It is a common expression for the journeyman to say he is earning all he gets. If that is all he is doing, his employer cannot afford to have him around. If he is not earning more than twice what he gets it's the same thing. Some men are willing and anxious to do better, but do not know how; others want to do better, but the foreman or employer will not let them. In the latter case it is hopeless, except to change employers. In the other case the man may reasonably be asked a few questions, some of which likely never have occurred to him. Do you know how long it took you to do the last job you did? Have you taken any account of the wage cost of anything you are making right along? Have you kept track how much longer it takes you to do one job than another? Have you devised any better way to do jobs than the one first tried? Have you made any valuable suggestions to the foreman; have you given the apprentices the benefit of your experience? Have you stayed after quitting time, enough to more than make up the time you have lost? Have you ever offered to pay for the work you have spoiled, or even to lose your time wasted on the job? Do you spend an hour of an evening reading some trade paper? Do you always try, on a new kind of a job, just how big a cut and how high a speed your machine will stand? Do you know what speed your planer runs both ways, or what is the speed your lathe runs when the belt is on the different cones? When cutting long screws do you throw out the nut and run back by hand, or if the nut cannot be thrown out, do you throw the lathe in high speed to run back? Have you ever asked to have the work by the piece? Do you own your own tools, or depend on the shop? Do you ask for a heavy hammer when you have heavy chipping to do? Do you cut into a whole board to get a small piece? Do you look out to prevent waste of your employer's tools and materials? If you have done none of these things, what have you done to get better pay?

"If you are looking forward to the time when you can get a foreman's position, it shows a laudable ambition, but the place is one of the most difficult, and, except for the additional pay, one of the most undesirable. The foreman is between two millstones, or, like one of the millstones itself, being dulled by the men and repicked by his employers every day. If you are already a foreman do you consider it your sole duty to make all you can for the company. Or do you consider that your position rests on finding a soft job for the president's wife's brother? Or do you consider that the men have rights which it is as much your business to see respected, and they liberally paid for what

they do (if the company is prosperous), as it is your duty to see that the work is managed properly and to the interest of the concern?

"If you are employed in a shop where no inventor or tool-maker is regularly employed, it may be that you have to take the place of inventor and designer, as well as foreman; it's well to remember that you have rights as well as your employer, and that the employer has certain rights as well as you.

"It is best to have an understanding in this regard; but the law in this, I believe, agrees pretty well with common fairness. The proprietor has a right to use in his business what you devise, and though inventors are always jealous of their contrivances, you will find it much more to your interest to have your devices tried and used, though you get nothing for it, than have them die. Then, too, a fellow is fortunate if he can get his devices tried at another man's expense. The more you improve the facilities the more you increase the product, and the better your chances for a better position.

"In the case of a tool-maker, his inventions of tools for the firm are the property of the firm, or ought to be, as that is what he is paid for, and so, too, are such of the inventions of the superintendent as go to increase the product of the company.

"One of the most difficult things that a superintendent has to do, particularly if promoted from a lower position, is to keep from giving orders to the men direct, instead of through his foreman. Hard as this is for a superintendent, it is worse for the proprietor who has built up his business from a small beginning. When one has invented some machine or designed a new product, wrestled with the uncertainties of some precarious enterprise, made the thing go that would not go, managed men and run a business, it is no easy task to surrender the control of the details into other hands, and is one of the pangs of success.

"Having given the apprentice and workman some hints as to their duty to their employers, it cannot be out of place to question ourselves as to whether there are not duties we owe to our employees that we do not always think of. Do we deal with a workman as if he were a business man and consider that the few dollars that we pay him are as much his fortune as our holdings are ours? In any other transaction the other man has half the say. In our deal with our men is it not altogether too often that the man has nothing to say about it? We employers say, 'We will pay you so much,' and that so much is the least we can get men for. Under these circumstances why should not the workman say, 'Then I will do the smallest day's work that I can and keep the place.' If we owe any man of prominence money, we will send him a check; if we owe the bank we will hustle around and go and pay it; but if we owe a workman, a farmer or a laborer anything, he must come and get it. Are we making money by insisting upon our foreman cutting down wages to the lowest possible point and saving all we can, amassing a fortune to endow some college, or reversing the thing, as has been done, putting down another $30,000 Fellowship fund, coming home and saying to our foreman, 'How many workers have you at work?' 'Six hundred.' 'How much are you paying them a week?' 'Six dollars.' 'Well, cut down their pay a dollar a week.'

"Do we pay our men all we can afford to because we pay the going wages? If we are making 25 per cent. per year on our capital, are we sure the men get their share of it? If we are profiting by a patent, how much of the invention is our own, and how much did our men do about developing it that we have forgotten all about? Have we any old men who have grown gray in our service, that are worth no more to-day than when they began, and if so, is it all their own fault or partly ours?

"Since writing the part of this paper that relates to shop schools, there have appeared two papers that would, to a casual observer, tend to upset my argument. One entire number of the "American Machinist' was devoted to the apprenticeship question, and by their returns it is shown that one-half of the machine shops replying to their inquiry do take apprentices, and some say it pays them, others do it on principle; but the most say it's because it makes them the best men for their particular work, which is equivalent to saying they are specialists and not all-round men. The other paper is a very able address by John H. Converse, before the students of Lehigh University. The speaker advocated, in addition to the regular technical courses and workshop experience, that the students first obtain a classical education, that they not only be engineers but the peers of any men. For an engineer, I should favor the classical education as well as the workshop, if the student could afford it; but to admit that the classical education is necessary to make the engineer 'the peer of other men' is conceding too much for the classical education; for it seems to me that Abraham Lincoln and General Grant needed no classical education to put a lustre on their glory; nor does Appleby, who invented the crowning gem of mechanics, a device to tie a knot in a string, which has been worth millions to the farmer; Bessemer, whose invention in commercial importance has been second only to the invention of Watt; Corliss, whose name in steam engineering will always be second to the great master, Watt, and Deering in agricultural machinery; Fulton and the steamboat; Goodyear and rubber; Howe and the sewing machine; Jacquard and the looms; Krupp and guns; McCormack and the reaper; Nicholson and files; Perrin and the band saw; Roberts and standard gages; Stephenson and the locomotive; Thurston, Unwin and Varney as educators, and Watt, who did more for civilization and advancement of the world than any other man within the last 1,800 years. Do these or any of the other ten thousand mechanics who have done so much for mankind, need to stand in awe or surrender the proud position they have the right to hold, to the many educated who have done so little except to exalt their own importance? In other words, is it necessary for the man who makes something of use out of useless material, and who has done something to benefit mankind and the world, to admit that the man who knows a lot which is of no use to anyone but himself is his superior? Is to *know* of more account than *to do?* Are the historians of more account than the men who make history?

"I have referred to the making of our work works of art. Who has not seen a beautiful shoe, not beautiful by decoration, but beautiful in shape—was it not a work of art? Who has not seen beautifully dressed men and women—were not their dresses also the work of artists?

"Is not the work of our carriage and cabinet makers, at their best, works of art, and is the carriage any the less a work of art because of its moving mechanism than is the cabinet at rest? Is the cabinet for bric-a-brac necessarily any more beautiful because of its utter uselessness than the sewing machine because it is useful? It may be so because the maker of the cabinet has no thought but of beauty, whereas the maker of the sewing machine thinks of the machine first, and looks afterwards: he has trained his mechanical faculties and neglected the artistic. The carriage designer trains both.

"This is a strange feature in the inventor; when he has invented a machine he thinks he can design it, while it is an entirely different thing, and the ability to design is far more rare than that to invent. When anyone wants to build a house, he employs an architect to design it for him; but the inventor or machinist designs his own machine, and they too often look as if 'someone did it himself.' This training of the designing faculty in our machinists has scarcely ever been thought of, and has never been attempted in workshop or school, and so little is known of it that but one in a hundred can tell the good design from the bad, and yet a perfect machine is a work of the highest art, for the artist is confined to the most rigid requirements; he is robbed of the use of all ornamentation, limited in space and material, and yet to one trained in the art, the machines of Sulzer, of Switzerland; Steinlen, of Alsace; Schneider, of France; Muir, of England, and Bement or Richards, of this country, are things of beauty.'

The Octoid System of Gear Teeth.

Several readers have referred to the occasional use in our columns of the word "octoid," as descriptive of a system of bevel gear teeth, and have asked for an explanation of the term. As this system is but little understood and is often confounded with the involute system, a few words of explanation would seem to be appropriate.

The historical method of treating gear teeth is to first determine the system of curves forming the outlines of the teeth, and the epicycloidal and involute systems are usually discussed from this standpoint. The rack being a special case of a gear, its profile is a special case of the general system of tooth curves, and by the above system of treatment the rack tooth curve is the outcome of the general system of curves decided upon at the start, and, as is well known, in the involute system is a straight line. As is also well known, the profile of a gear tooth may be assumed at random, and a mating or conjugate tooth may be found which will work correctly with the assumed curve and with all similar conjugates belonging to gears of various sizes. In this way an indefinite number of tooth curve systems may be originated. For instance, a gear might be made with circular tooth profiles, and mating curves might be found which would not themselves be circles, but which would mesh correctly with the original circular profile and with each other. This original gear might be of any size, and it might be a rack.

Should such a rack be employed with straight profiles, the resulting conjugate profiles would be involutes, because the involute profile for a rack is a straight line. Again, had the rack a cycloidal outline, the resulting conjugates would conform to the epicycloidal system. This system of originating tooth curves will be seen to be the reverse of the historical one. In the latter the rack curve is at the end of the process and is a development of the general system, while in the former it is at the beginning and is the base of the system. The Fellows gear shaper is an example of the newer method applied to spur gear cutting, a straight-sided rack tooth forming the starting point of the system, from which a cutter with conjugate teeth is generated, and which in turn generates conjugate teeth in the gears. With the Fellows machine the resulting curves do not differ from those obtained in the usual way on the involute system, the difference between the Fellows and the older methods being mechanical rather than geometrical.

With bevel gears the analogue of the rack is the crown gear, the tooth profile of which is a special case of the general tooth curve system, precisely as with a rack, and by assuming the crown tooth profile, various systems of bevel curves may be originated, as with a rack and spur profiles.

Now, while the rack tooth profile of the involute system is a straight line, the crown tooth profile of the same system is not, but is curved, as with other bevel teeth, and the adoption of a straight-sided crown tooth results, therefore, in a new system of tooth curves, which is called the octoid system. The straight-sided crown tooth is adopted because, being the starting point in these systems of construction, it must be easy to originate, and this condition is, of course, best met by the straight-sided tooth.

The name of the octoid system is derived from the fact that the form of the path of the point of contact with complete teeth is a figure of 8 curve, as shown by the line *a b* in the accompanying Fig. 1, which represents an octoid crown gear. The octoid system was first employed, and in fact invented, by Mr. Hugo Bilgram, all bevel gears cut on his well-known generating machine having such teeth, and the same is true of all generated bevel gears which are originated from a straight-sided crown gear tooth.

The octoid has been widely confused with the involute tooth, owing to the erroneous assumption that an involute crown gear tooth has straight sides like a rack tooth. The first publication of the facts was, we believe, contained in an article by Mr. George B. Grant, published in our columns for October 13, 1890, and since republished in his well-known book, "Odontics."

The difference between the octoid and involute crown gear tooth can be seen by comparing Figs. 1 and 2, which are reproduced from those published in connection with Mr. Grant's articles. Fig. 1 shows the octoid and Fig. 2 the spherical involute. With the latter the path of the point of contact is the great circle *a b*.

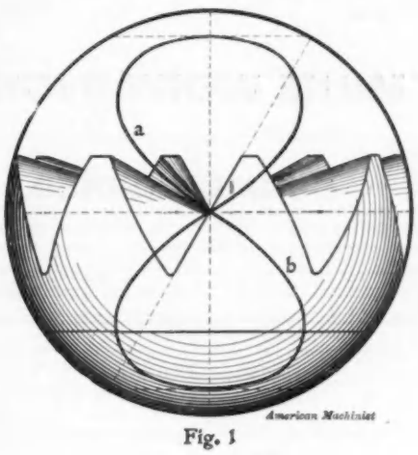


Fig. 1

THE OCTOID TOOTH.

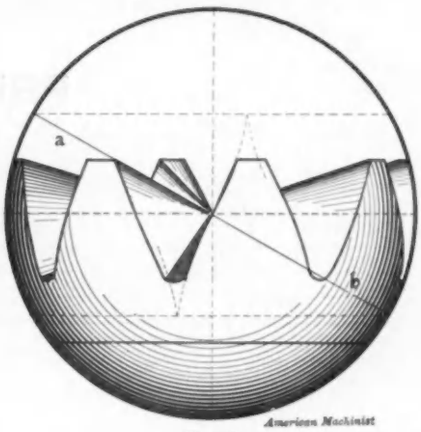


Fig. 2

THE INVOLUTE TOOTH.

A Locomotive with a Corrugated Furnace.

A locomotive embodying a radical departure in boiler practice has been put into service upon the New York Central Railroad. The furnace in this instance is round and corrugated, and is placed eccentrically in a round boiler shell, thus avoiding entirely the staybolt nuisance, which constitutes one of the most serious troubles in locomotive service. The furnace, which is said to be the largest of the corrugated type ever made, is 5 feet 3⅜ inches in diameter and 11 feet 2 inches long. The outer shell of the boiler, at the firebox, is 7 feet diameter inside. The steel of the furnace is ¾ inch thick. The grates, which are 8 feet long, have a drop toward the front of 8 inches in their length. The furnace is carried at its front end by a row of sling stays, and the pressure against the forward end of the furnace is resisted by the tubes and by stays attached to an annular re-enforcing plate and forward to the waist of the boiler. There are two firing doors and an opening to the ash pit. The tube heating surface is 1,920 square feet, and that of the furnace about 90 square feet. The total weight of the boiler is considerably less than that of the regular boiler of this class. It is said to be a free steamer, and the engine is pulling as heavy trains as other engines of the same size. The engine was designed in the offices of the superintendent of motive power by Mr. Cornelius Vanderbilt, Jr., who graduated from the Sheffield Schientific School, and is now enthusiastically engaged in the practical study of railroad engineering.

A Peculiar Accident.

At the Potts Brothers' Iron Works, Pottstown, Pa., a workman, Harry Fox, recently met with a peculiar accident. A pair of large tongs in his hand were caught in a revolving drum, striking him on the chest and knocking him down. His breastbone was fractured and his windpipe was crushed for several inches. The latter injury caused the air to get under the skin, and his neck and face were puffed up to twice their natural size. Air in the wrong place is as bad as anything else. He will recover.

Order No. 465 **PREMIUM WORK TICKET.** The Time on Record for this Job is 22 hrs. on 20 Pieces.

Commenced June 30 189 9 Engine No. _____ Finished July 1 189 9

7.00 A. M. _____ P. M. **TIME WORKED.** _____ A. M. 6.00 P. M.

MONTH.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Straight	Back	Total.
June																														10				20
July	10																																	

No. Pieces.	Size of Piece.	Name of Piece.	Limit Time Each.	Total.
20	8 X 10	Crossheads	1½ hrs.	4.52

Operation Planing

Tool Planer Name of Workman John Smith Clock No. 75

This work is finished and found correct. P. K.

NO WORK WILL BE PAID FOR UNLESS TIME AND OPERATIONS ARE SPECIFIED FULLY AND CORRECTLY.

Order No. 494 **PREMIUM WORK TICKET.** The Time on Record for this Job is 14 hrs. on 1 Pieces.

Commenced July 2 189 9 Engine No. _____ Finished July 3 189 9

7.00 A. M. _____ P. M. **TIME WORKED.** 10.30 A. M. _____ P. M.

MONTH.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Straight	Back	Total.
July		10	3½																															13½

No. Pieces.	Size of Piece.	Name of Piece.	Time Limit Each.	Total.
1	12 X 12	Subbase	18 hrs.	3.00

Operation Planing

Tool Planer Name of Workman John Smith Clock No. 75

This work is finished and found correct. P. K.

NO WORK WILL BE PAID FOR UNLESS TIME AND OPERATIONS ARE SPECIFIED FULLY AND CORRECTLY.

The Premium Plan at the Works of A. L. Ide & Sons.

BY HERMAN FERNSTROM.

Having had considerable experience, both satisfactory and otherwise, as one may chose to look at it, with the piece-work system as ordinarily applied, I cast about for a better method of inducing the more rapid production of chips, and finally concluded to try the premium plan, and from results up to date I am confident that for most work done by day or piece it offers by far the most advantages. Several methods of dealing with this system have been shown in the pages of the "American Machinist," but they all seem to be more complicated than necessary. Any system should be of such character as to be easily understood by the men in the shop, not taking too much of their time in figuring their accounts, nor requiring an undue amount of clerical labor. That which I am about to describe meets these conditions a little closer than any that have come to my notice, and should a simpler one exist I would be glad indeed to hear of it. In working out the ratios to be allowed as premiums, it being understood that time, not money, is primarily allowed, we are at once confronted with two extreme conditions. One is to allow time as near to that established by records as possible, making the premium large, and the other to allow a liberal amount of time, but making the premium small. The nearer we come to the first condition the more of the objections of the piece-work system will be encountered, whereas by the second the flexibility increases and the objections will be largely overcome. The conclusion was, therefore, to adopt the second—that of making liberal allowance of time, but making the premium small, and the results show that no mistake was made in this.

An obstacle arose, however, in direct consequence of this decision, but it was not of a very serious nature, and it has been largely overcome, as will appear later. General time keeping is from a clock that registers the time of entries and departures on a strip of paper, together with the workmen's numbers, such as is now so common in modern establishments. Time tickets, shown in the illustrations, are issued in lots from the office to the foremen of the different departments, who in turn furnish them to the men as needed, a ticket being issued for each operation. This time slip is a modification of one that, so far as I know, is original with Mr. Whitehill, at one time superintendent of the link and motion department at the Allis Works, and it deserves more than a passing notice. It will be seen that by leaving out the price and time allowance it is a day-work slip, while by putting on a price it becomes a piece-work ticket, and by allowing time instead of price it answers for the premium plan. It is best, of course, to change the heading and color of the paper for the different uses, as this will make the work of assorting in the office much easier. In most shops where parts are made and kept in stock, it frequently happens that work on a piece must be suspended for something more pressing, and the lapse of time until it can be taken up again may at times be as great as two months or more. It will be seen that the slips provide for this by having three rows of blank spaces, one space for each day and one row for each month, the month to be marked in at the first end, so only one slip is needed for each operation on each piece, and when finally the slip is returned to the office, which is not done until the work it describes is completed, it carries with it the whole story, and need only be filed together with its mates to give the total labor cost. The foreman, in giving out this slip, notes the exact time thereon, also

Order No. 473

PREMIUM WORK TICKET.

The Time on Record for this Job is 14 hrs. on 1 Pieces.

Commenced July 3 189 9 Engine No. Finished July 4 189 9

10.30 A. M. P. M.

TIME WORKED.

A. M. 4.00 P. M.

MONTH.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Straight	Back	Total.
July			6½	8																														14½

No. Pieces.	Size of Piece.	Name of Piece.	Time Limit Each.	Total.
1	20 X 20	Steam Chest Cover	20 hrs.	3.28

Operation Planing

Tool Planer Name of Workman John Smith Clock No. 75

This work is finished and found correct. P. K.

NO WORK WILL BE PAID FOR UNLESS TIME AND OPERATIONS ARE SPECIFIED FULLY AND CORRECTLY.

DAY WORK TICKET.

Order No. 492 Engine No. Given out July 4 189 9

TIME WORKED.

Finished July 5 189 9

MONTH.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL.
July				2	10																											12

No. Pieces.	Size of Piece.	Name of Piece.
12	12 X 12	Frame Doors

Operation Planing

Tool Planer Name of Workman John Smith Clock No. 75

when it is returned to him. The nearest quarter hour is taken as the smallest unit of time. The premium scale, shown herewith in abbreviated form, together with "Directions," is furnished each man likely to be engaged on premium work, and completes the arrangement. The "Directions" read as follows:

"The first column on the left-hand side corresponds to the time limit given on time slip. The figures at the top of table correspond to the time you have reduced time on job from the limit given on time slip. By tracing the time line out to the columns of your reduction you will find your premium rate thus:

"If you are given a time slip with time limit of 20 hours marked on it, the work being done in 12 hours, it follows that a reduction of 8 hours has been made. Trace outline 20 till you get to column 8, which reads 1.21—your premium rate. Then figure your wages on the 12 hours on job. Suppose it to be $2.40. Multiply that by premium rate, 1.21, which gives $2.90—your pay for the job—or 24 cents per hour. Again, suppose:

"Same time as before, with the difference that you have only made a reduction of 2 hours. Then, by same process you will get a premium rate of 1.05, which gives you 21 cents per hour."

To save type-setting, the table is abbreviated, but the figures covering the case just stated are given, and it will be understood that in the full table rates are carried out to meet all likely conditions. Also note that for the first 10 hours, quarter hours are taken as units; next 10 hours, and above that, whole hours.

The reason for this is obvious. The time given in "Directions" will serve to illustrate the one difficulty encountered. Suppose 20 hours were allowed on a job. As we make a liberal allowance for time limit this would be considerably more than the average time on previous similar work, and if the work was finished in say 12 hours it instantly occurred to the majority that the premium was out of all proportion small to the time apparently saved. It is well known that in all piece work shops time records are scrupulously kept among the men, and any change is instantly pounced upon, but in this case the records seemed to have been suddenly lost, and innumerable were the complaints about this abnormal difference of apparent saving of time and its small recompense. I explained in each case that the time as given on the time slip was not the actual record time, but far in excess of it, and hit upon the plan of marking on each slip the record time, as shown on upper right-hand corner of the time slip. This would be, of course, the best time made for a similar operation as shown by the records. This, gradually coming to be understood, has smoothed most of the ruffles, and it serves some good purposes, as the workmen can at a glance see if the time as made by them compares favorably with the records, and it will indicate to a new man what is expected of him. Now, as to the simplicity. One subtraction and one multiplication only are required. The time given on the slip gives one factor, and the time saved another, from which is found the third, and the total wage, whatever it be, is multiplied by this third, and the accounting is done. This should be a real boon to those who have tussled with the many rates of the piece-work system, because evidently one cannot allow the same price to the apprentices as to skilled mechanics, even though they, for the time being, are employed on the same class of work, and this necessitates many rates, often four. The 1's on the premium scale stand for the hour-rate wages, whatever

NAMES	NO.	30	1	2	3	4	5	6	HOURLY RATE	PREMIUM WORK	DAY WORK	TOTAL	AMOUNT PAID	AMOUNT DUE	
J. Smith	75									48	12	60		8	20
		10	10	10	10	10	10		20	10.80	2.40	13.20	5.00		

TIME SHEET FOR WEEK ENDING JULY 5, 1899.

TIME SAVED

TIME LIMIT	¼	½	¾	1	1¼	1½	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4¼	4½	4¾	5
½	1.60																			
¾	1.30	1.60																		
1	1.20	1.25	1.35																	
1½	1.08	1.18	1.26	1.30	1.34															
2	1.05	1.10	1.15	1.18	1.22	1.27	1.30													
	½	1	1½	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
18	1.01	1.03	1.04	1.06	1.07	1.08	1.09	1.10	1.11	1.13	1.15	1.17	1.18	1.20	1.21	1.22	1.24	1.26		
19	1.01	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.12	1.14	1.16	1.17	1.20	1.21	1.22	1.23	1.25		
20	1.01	1.02	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.11	1.13	1.15	1.17	1.19	1.20	1.21	1.22	1.24	1.26	1.28
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	1.03	1.06	1.09	1.10	1.11	1.12	1.13	1.14												
22	1.03	1.05	1.07	1.08	1.10	1.11	1.12	1.13	1.14											
23	1.03	1.05	1.07	1.08	1.09	1.10	1.11	1.12	1.13											
24	1.03	1.05	1.07	1.08	1.09	1.10	1.11	1.12	1.13	1.15										
25	1.03	1.05	1.06	1.08	1.09	1.10	1.11	1.12	1.13	1.14										
26	1.03	1.04	1.06	1.08	1.09	1.10	1.11	1.12	1.13	1.14										

PREMIUM SCALE.

they be. The real hard work is in obtaining a suitable table of what might be called constants, that shall give each one concerned a fair share, and, above all, to be so "approximately correct" that no change shall be found necessary under same conditions.

The four time slips cover an entire week's work by John Smith, and the section of the time sheet or pay roll for the week shows how the wages account is kept. The ten hours per day attendance at the shop are taken from the clock record, as already explained. Adding the time and wages accounted for on the premium tickets shows forty-eight hours of premium time and ten dollars and eighty cents wages earned on premium work. These are entered in the proper columns, and the remaining twelve hours are entered at the hourly rate. The sum of premium wages and day wages gives the total earned.

The "Amount Paid" is either money advanced, or if, as frequently happens, a premium job runs over into the next-week, the hours put in on it will be paid for at day rates and be accounted for the following week by being placed in the "Amount Paid" column for that week.

The items "Straight" and "Back" on the time slip have nothing to do with the premium system, to which this article relates. Overtime is otherwise taken care of, it being the practice of this firm to have as little of it as possible, and it is astonishing how little there need be of it if one tries.

It will be seen that all the accounts necessary to make up the pay roll for one man are here shown, and they include premium work, day work and all, besides the time slip itself is a complete record of the job—how long it took, when it was made, what it cost and all about it, and this is of no small importance in case something should happen to parts in actual service. We stamp in each piece the order number, and we can in this way tell who planed a crosshead that went out to, say, Japan, ten years ago, if we are told the order number stamped on it, and all at no more cost and labor than that needed to make out the pay roll.

Springfield, Ill.

[Mr. Fernstrom's method is certainly very neat, simple and original. There can be no room for doubt that his method of liberal time limits and moderate premiums is the sound one, although the natural tendency of most people is to adopt the opposite course. That this is a serious mistake has been pointed out in these columns already, but it cannot be too often insisted upon. Many inquiries regarding the progress of the plan reach this office, and the readers of the "American Machinist" will be glad to be informed that eighteen establishments have now been reported as having introduced it, or as having decided to give it a trial. Most of these are in this country, but England, Germany, Belgium and Italy also appear on the list. It is scarcely to be supposed that this list is complete, and readers connected with, or knowing of, shops which use it or contemplate a trial of it, are particularly requested to send in the infor-

mation, and, where possible, to give any peculiarities of its application, and especially the results obtained. The "American Machinist" has no hobby to ride in this matter, but believing the plan to at least offer a promise of improved relations between employers and employees, and of increased prosperity to both, it is believed that its columns will be well used in supplying information regarding its progress and conduct and the results obtained by it. F. A. H.]

Making a Compound Watch-Wheel Die.

BY LUNDVALL AND KLUTE.

Accurate tools are required to produce good wheels for good watches. Fig. 1 shows, in vertical section, and Fig. 2 in plan, a "sub-base" such as used in, we might say, all watch factories. The sub-base consists of (the dies excepted) the stand *A*, the plunger *B*, the base *C* and nut *D*, to tighten the babbitt lining. The stand *A* should first be faced and bored on the bottom, not forgetting to face and recess the barrel to suit a flange by means of which the plunger *B* is centered at one end for babbitting. The stand should then be drilled and tapped for fillister head screws, by means of which the stand is secured to the base, and also fastened to a special lathe chuck, by means of which it is bored 3 degrees taper, faced on end and turned for nut, but not threaded until the stand has been babbitted. After the stand has been bored, it should have four or five grooves planed on the inside, parallel with the taper to prevent the babbitt from turning. It is now ready for pouring, providing the plunger is ready. The plunger *B* should first be rough turned, then back-rested and bored for the spring piston, after which it should be threaded for the button *E*. This should be made of machinery steel, having two flats milled on it at *a a*, so as to be able to remove it from the plunger. With the button well screwed down, the plunger should be turned to .005 inch of the finished size and finished by grinding, making sure to have it perfectly parallel; after which it should be placed in a planer vise, and four grooves planed. Make sure the planer vise is exactly in line, or you will have a twisting motion to the plunger, and it will play the old Harry with the dies. Now draw-file the plunger, using a No. 2 emery stick, which will give better results than a file, and we are now ready for babbitting, having first made the top pouring plate, which should be bored the exact size of the plunger, and recessed to suit the top of the stand, allowing the babbitt to rise ⅛ inch above the stand. As soon as the stand has cooled enough to handle, the plunger should be forced down far enough to allow the babbitt to be squared off on the end, and the thread cut on the end of the stand for nut *D*. Remove the plunger from the stand, and place the stand on the special chuck in the lathe again, and cut a spiral oil groove, about 1-inch pitch, in the babbitt lining. The stand and plunger should now be secured in a power press, and pumped, giving plenty of oil, and tightening down the nut occasionally so as to get a good bearing. It must be watched at this stage, as the excessive friction will soon heat the babbitt lining, causing it to swell, and making it liable to pull the stand to pieces. The stand should now have the bottom refaced and bored out 2 degrees taper to fit over the boss on the base. The plunger should now be removed from the stand, back-rested and recessed for the dies. The base may now be clamped to the face-plate of a lathe, having previously planed the bottom, and the boss turned 2 degrees taper to suit the stand, also recessed for the dies and lower shedder, after which it is drilled and counterbored, and then screwed fast to the stand; and lastly, two good steel taper pins inserted to secure the alignment of base and stand.

The dies for a compound wheel punch consist of seventeen pieces, including the top and bottom shedder. There are five segmental punches *F*, one center punch *G*, five filling-in pieces *O*, one spider *H* to go in between the five segmental pieces, one ring *I* to fill in the space between the outside die and the five segmental punches, one ring die *J* to punch the outside of the wheel, and also three round rods forming the connection between the upper shedder and the bottom of the spring piston. These are all to be fitted to the plunger. The five segmental punches are planed in one piece to the proper angle (in this case

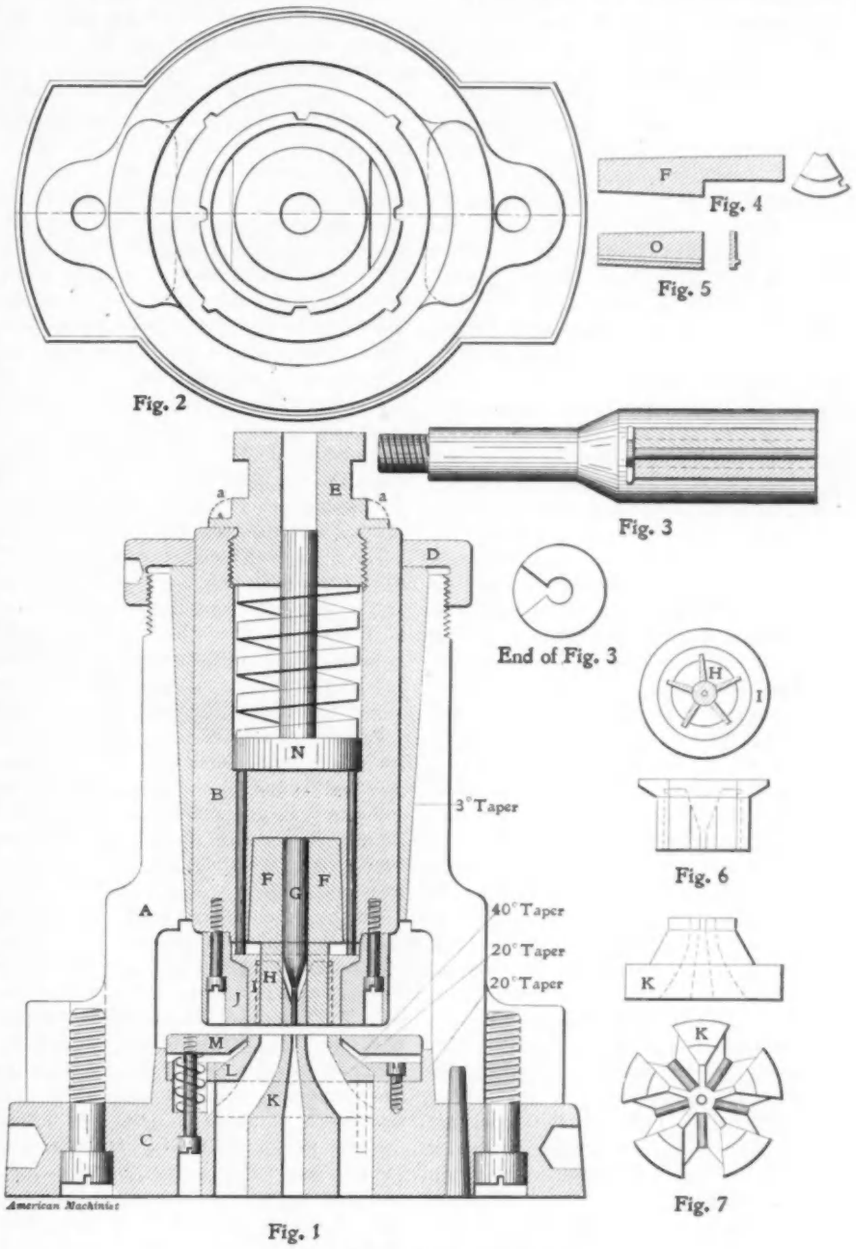


Fig. 1

COMPOUND WATCH-WHEEL DIE.

75 degrees, in order to have the necessary taper to the arms of the wheel); a groove is planed in on one side to suit the key on the filling-in pieces. They are then cut off long enough to allow turning on the ends, after which they are turned on a special chuck in a bench lathe.

The best way to make the chuck, Fig. 3, is to make a blank chuck of a diameter somewhat larger than the inside diameter of the wheel that you wish to punch, bore a hole in the chuck, the same diameter as the hub of the wheel, and fit in a plug, allowing it to project about ¼ inch, which end should be turned in diameter to suit the thickness of the arms. It is necessary now to cut the clearance in the back of the chuck before you can plane it. A fixture must be provided for the shaper on which the head of a bench lathe can be fastened, so that the chuck may be shaped to the proper angle when in place in the lathe head. It may be planed by throwing the shaper head 37½ degrees to each side, using the guide pin to plane to, or leaving the shaper-head in vertical position and planing across, using the guide pin to plane to, and then swinging the lathe-head through an angle of 105 degrees, when the other side may be planed in a similar manner. Having finished the chuck, we now proceed to turn the outside of the segments, Fig. 4, by clamping each fast with a ring in which we have previously tapped a set screw. Turn the segments half way, allowing .01 inch for grinding, and finish the other half. Bore the segment of hole, allowing .003 inch to grind, and turn the ends all to one length. Harden at as low a heat as the piece of steel will harden, and draw enough to take out the shrink. Now carefully lap the sides down on a good cast-iron bench block, so as to get good smooth sides, being careful to maintain the proper angle. The segments are set into the plunger on a 1 degree taper. After lapping, take the segments one at a time, clamp in V-chuck, and proceed to grind each segment square on end, also grinding it lengthwise on a 1 degree taper, taking care to have them all one diameter, using a slide spindle grinder on a bench lathe.

The filling-in pieces, Fig. 5, are planed in one piece, and of the proper taper, with a key on one side, and cut off long enough to come flush with the recess. A chuck blank is made .1 inch larger than the inside diameter of the rim of the wheel, and long enough to form the spindle *H*, Fig. 6, on the end. With the bench lathe head fastened to the fixture that was made for the shaper, proceed to mill out the arms with a suitable roughing cutter, and finish milling with a special cutter, which must be made for each different size of wheel. It should be milled and fitted a snug working fit, between the five segmental punches. Return it to the lathe, and drill and bore the large hole in the center to suit the center punch *G*, and cut off to length, allowing for facing in brass chuck, when the small hole should also be drilled. The small hole in the spider serves as a guide for the center punch, and should be ground after hardening. Harden and draw to a purple, and should it require any fitting after hardening, use a copper hand-lap, charged with diamond powder. The ring *I* into which the spider fits should be turned with a recess on the inside, as shown, and secured in a brass chuck fitting the bench lathe head, and five grooves planed on the inside, deep enough for the spider arms to go in a snug fit, after which it is hardened and drawn, and then ground inside and outside, after which the spider may be soldered at the joints. The outside ring die *J* should be made as shown, hardened and drawn to take out the shrinkage, and ground all over, fastened with from four to six steel screws, which should be hardened and drawn to spring temper. The die should have a fine saw-cut passed through to the screw holes on the outside, to prevent it from cracking in hardening. Now back-rest the plunger, in the bench lathe, letting it revolve in a ring; bore out the recess for the ring die and make it a tight drive fit; also bore out the taper hole 1 degree taper for the punches and make them a good driving fit.

The segmental punches may now, while still in the back rest, be ground in place on the outside to suit the inside diameter of the rim of the wheel, and the hole ground out to suit the diameter of the hub of the wheel, and also that the hub of the spider fits. The hub of the spider must be the same diameter as the hub of the wheel. The small hole in the spider may be ground at the same time or by securing it in an extra brass chuck. Drill the three holes in the plunger for the round rods, assemble the dies and grind them off flush.

The base having been turned and bored, the next step is to get out the bottom punch K, Fig. 7. The blank should be well secured in a brass chuck milled out with a roughing cutter, and finished with the same mill that finished the spider. After milling, it should be fitted to the five segmental punches, and with the punches as a guide it should be forced into the proper position in the base, with the base and stand fastened together, after which a good-sized dowel pin should be drilled through the die *K* into the base. Harden the top end of the punch, draw and grind the arms to finished size, giving the small center hole ¼ degree back taper. The round blanking die *L* is plain sailing, also the bottom shedder *M*. The base should have the clearance holes cut through to allow the punchings to fall. The wheel punchings strip back into the brass strip. There are eight springs under the bottom shedder, and it is secured by four screws. Guide-pin holes should be drilled in the shedder before hardening, and which should be drawn to a blue.

Letters from Practical Men

Quick Sketches of Tools.

Editor American Machinist:

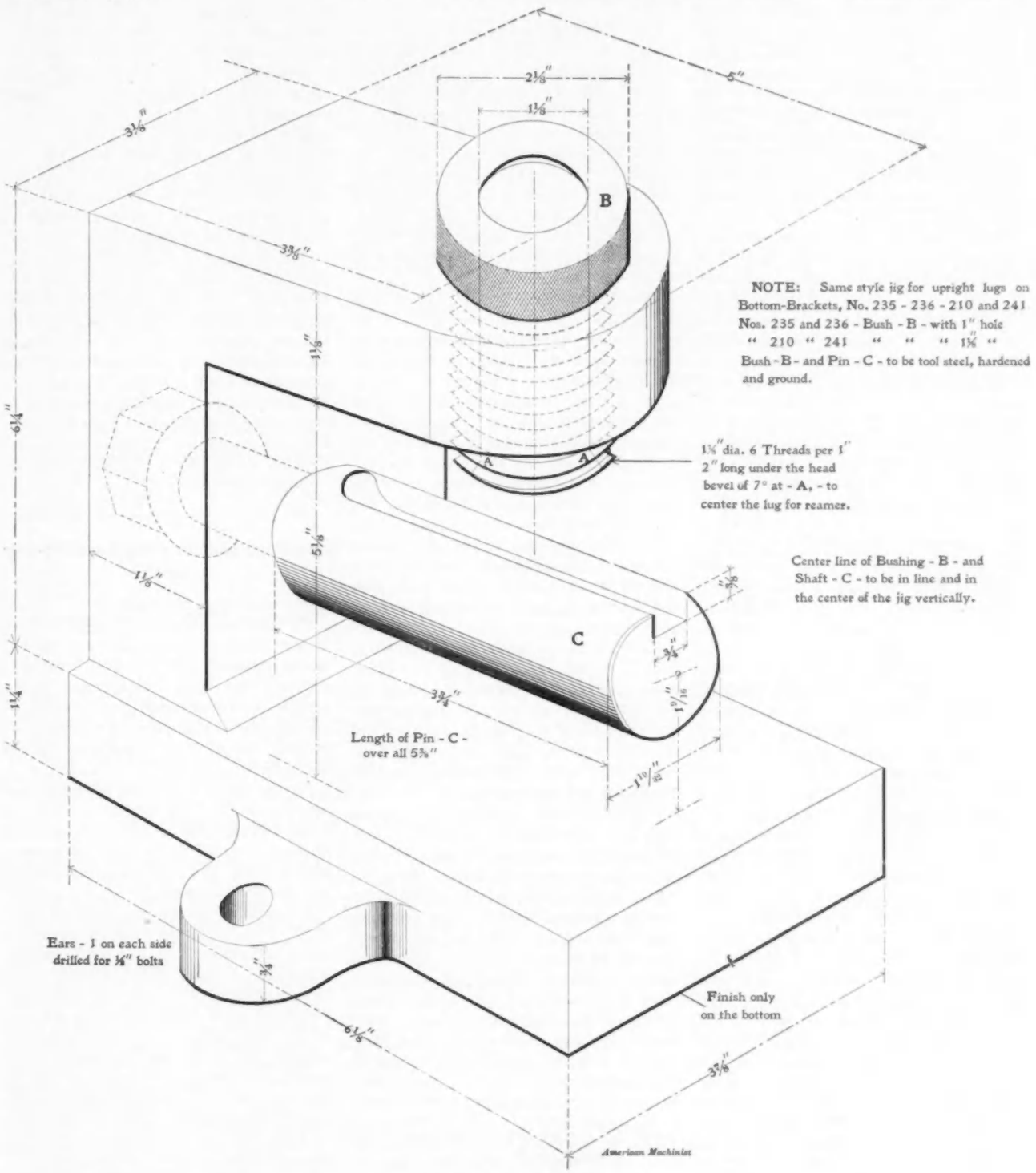
I present to your readers a drawing and a description of the same, which may provoke a smile of disdain from some of our highly polished friends among the draftsmen, but I feel sure will meet with the approval of some of our shop associates. It is a simple one of many such that I have made on a block of thin bond paper, using only a 12-inch scale, a pair of compasses and a pencil, afterwards inking and writing in notes to explain the uncertain points, then blueprinting in the usual manner, and filing the bond-paper sketch for future reference. The sketch has the appearance of a perspective drawing, while closer inspection of a practical eye will quickly reveal that no construction lines have been used, or even a center line for a basis to start on.

The sketch is supposed to represent a jig for drilling the lugs on a bicycle bottom bracket casting, after the large hole through the barrel has been machined. I suppose I should say "forging" instead of "casting," as our catalog used to read, "All connections drop-forged from the bar steel of certain per cent. carbon, made specially for us and shipped direct from Norway (or Nebraska)," while, in fact, the said forgings were of a very fine mixture of iron, bronze and ———, which gave excellent results, very tough, pliant and easily machined, coming to us from the foundry, cored, leaving 1-16 inch to finish in the holes, with reamers, made four-winged style, and hardened about as hard as a cherry-red heat and cold salt water could make them, which was demanded owing to the speed of the gang-drill spindles, traveling through those "forgings" at the rate of about an inch every dozen revolutions of the reamer, and kept cool and lubricated by a mysterious-looking mixture of soda water, dirty lard oil and tobacco, attended by the promising (?) young apprentice, who was "given every opportunity to learn the trade" and a chance to double his wages on piece work, from 30 cents to 60 cents per day.

I fear, Mr. Editor, that I am deviating somewhat from quick sketches to rapid drill-press work, which perhaps could form the basis for an interesting letter at another time. Making tool sketches like the one here shown saves much valuable time of the draftsman, and is often more readily understood, demanding much less study from the practical pattern-maker or machinist than the drawing of three views and detail sheet, as regularly made by the draftsman and later "cussed" by the toolmaker. I have found it economy at times to make sketches of quite large and complicated fixtures in this style, of course having more "notes" written on the paper

than lines drawn. The time required for the accompanying sketch, complete, blueprinting included, was about one hour and forty-five minutes. D. E. MacCarthy.

E. Pittsburgh, Pa.



A QUICKLY MADE SKETCH.

Piece Work Versus the Premium Plan.

Editor American Machinist:

The several articles upon the premium plan of paying for labor which have appeared in the "American Machinist" have naturally excited more or less interest among your readers, especially among those who may be considering the advisability of changing their system of day work to one of the many devices offered for getting the utmost amount of product out of the labor employed.

To elucidate and explain the real merits or demerits of one or all the systems proposed would probably tax the patience of your readers and take up much of your valuable space; and I will therefore proceed to explain that, in the abstract, I do not see where the premium plan differs radically from the piece-work system. The paramount consideration deals with individual's predilection, and the final results will also be left to the tender cussedness of human nature, to bring peace and harmony in the family or to become a "discord breeder," quoting Mr. Halsey's remarks. As the object, under various pretexts, of piece work, premium plan, time limit, Taylor system, etc., is only to

spur the dormant ambition of the workman, and as the employee in turn aims by extra effort to increase the output for the sake of receiving an added compensation, a mutual acquiescence is reached, yet the motives may be very different.

If a given establishment possesses data a certain amount of consideration is given them and to the deductions from them by the person appointed for the purpose. He considers the question of how much time will be required to accomplish a certain amount of work, and in consideration of the time consumed (here is where your time limit comes in) fixes a price upon this basis.

For instance: Suppose his judgment determines three hours as the probable time of doing a given job. In this connection Mr. Halsey will concur that the assigning of a first time limit and of a premium for the majority of operations in a machine shop does not come under the category of exact science. He may be somewhat near, or he may be, as the workman would say, "away off." It very much depends upon personal familiarity with the conditions involved and general ability as a mechanic to place a fair estimate.

Very well, three hours being the limit and the basis, the piece-work price for a man rated at 25 cents per hour, would be 75 cents per piece. At the piece-work price the man reduces the time to 2½ hours, which nets him 20 per cent. increase, and he receives $3 per day for finishing four pieces.

Now, we take the premium system, and we say to the man: "We have assigned three hours to this piece of work, and we will allow you 12½ cents per hour, or its equivalent for any part of an hour, that you can gain on the three-hour limit." Now, imagine the possibility that, with all encouragement and with the prospects offered by our friendly premium plan, a fair limit is 2½ hours, as before. Then the man finishes four per day. His four pieces count him 10 hours at 25 cents, and his premium, 2 hours at 12½ cents, or his compensation per day will be $2.75. Now, supposing that the two systems were offered in the same shop—you would need considerable space between the two contending parties, and on the part of the arbiter there might be a strong inclination to think that "silence is golden."

Of course, the above conditions must apply chiefly to a concern working on general work and wishing to find new worlds to conquer, and taking up one or the other of the two systems, more or less elastic, to benefit both parties concerned; for Mr. Halsey very aptly tells in his pamphlet that the piece-work system is most successful in works where a continuity of work is done involving the production of large numbers of pieces, and therefore the premium plan in that case is left out in the cold.

Where the capacity of output is determined beyond question, then the individual or the corporation can place an arbitrary figure according to their respective individual ideas of what they consider proper. There is where human nature becomes the arbiter.

I have no desire to antagonize Mr. Halsey's system. No doubt it was conceived from commendable motives and has often secured different results from what I have attempted to show. I also concur in what touches upon the frailties of human nature as the principal factor; but as the question to my mind hinges upon the estimated time in which a piece of work might be done and a price placed according to the time required, you cannot change the principle by any system, no matter how designated.

The idea advanced by Mr. Halsey that the premium plan will accomplish more by removing the tendency to cut prices, as in piece work, as it places no limit upon the rates which a workman is able to make, I think is untenable, simply from the fact that it does not remove the element of doubt in estimating the time limit in the first instance. But presuming that the same conditions are offered under the piece-work system, and allowing the man the same fixed ratio of time limit to the price, to develop the utmost output, and giving him to understand that the price will not be changed, I do not doubt that self interest in one case would give as good results as in the other.

I will say in conclusion that, as all roads lead to Rome, and a rose by any other name may smell as sweet, the results of any system, no matter how named, will reach the same conclusions, for they are all subject to the same tendencies. Human nature will, to a certain extent, be the arbiter and final readjuster. Mr. Halsey or any other gentleman connected with any manufacturing concern, would not hesitate to cut down any price when it reached an unreasonable figure. How can it be possible that when an operator reaches the same results by the premium plan or by the time limit that any exception will be made in his case? Therefore, can it be that the *name* will exempt it from the inevitable? I doubt it. There is a limit to all things, and when the question of doubt is removed as to the limit, then the premium plan, like its prototype, the much-abused piece-work system, will be shorn of its beauties and brought down to its proper level. DULCET.

[As has been said in these columns before, while the premium plan does not make rate cutting impossible, it does make it unnecessary; while with piece work rate cutting, sooner or later, becomes imperative. No employer can contemplate paying the same wages cost for his product for an extended series of years, and under piece work a reduction of wages cost can only be brought about by a cut in the rates. With the premium plan the reduction in wages cost is accomplished automatically, every increase of output and of earnings being accompanied with a reduction of cost. Hence with the premium plan the employer can say to his employee, "Your earnings shall have no limit except that determined by the amount of work you can turn out," while with piece work this is impossible. In the case cited by Dulcet the workman's earnings are larger under the piece work plan, but if the time consumed be supposed to be reduced much further the earnings will soon reach a point where a cut will become imperative, while the opposite is the case with the premium plan. The case in a nutshell is this: With the premium plan every increase of wages involves a corresponding automatic reduction in wages cost, while with piece work that reduction can only be brought about by a cut in the rates, and the effect of such a cut is to punish the workman for his previous efforts. That all employers will resist the temptation to cut the premiums is perhaps too much to be expected, but that does not change the fact that, with proper premium rates to begin with, it is to their best interest to do so. —F. A. H.]

Punching and Shearing Small Spring Steel.

Editor American Machinist:

The sketches show a sub-press and set of dies made to punch and cut off flat spring-tempered steel about ⅛ inch wide and 1-64 inch thick. The temper of the steel is somewhat lower than that of an oil-tempered spring drawn by burning off the oil, yet is hard enough not to cut easily.

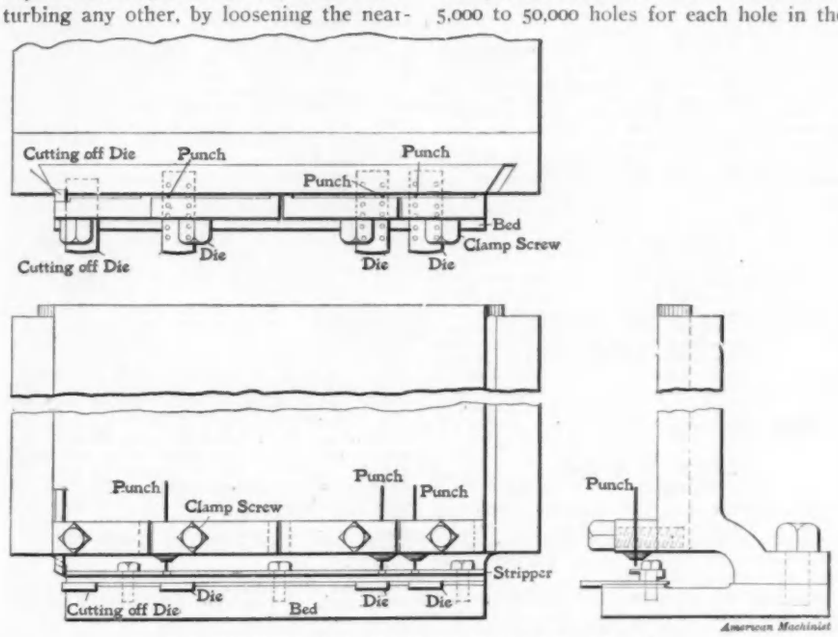
As the work wears out the dies and punches very quickly, it was necessary to adopt a design that would permit a rapid change of either or of both, to replace broken ones, and the easy removal of punches for sharpening.

The punches are straight pieces of "drill rod," about 4 inches long, hardened in water and drawn to a blue in the middle, where the pressure of the holding clamp tends to break them, and the ends left a very light straw color. They do not need to be very straight, as the clamps are smooth, and by placing the punch in the clamp with the curve to right or left, the end will be in the same plane as if the punch was straight. They are sharpened on both ends, and when dull are reversed, thereby saving trips to the grinder.

The dies are ⅛ inch thick and ½ inch wide, and have no finish except to grind the scale off the top side and true the edges with a file to fairly fit the recess in the bed. The holes are drilled in a jig, and the only accuracy called for is that they shall be true to size and the same distance from the nearest edge of the die. The die is first placed in the jig and each

hole started, then removed from the jig and drilled through with a drill smaller than the required size. Clearance is secured by drilling about two-thirds through from the back side, and then a sizing drill through each hole completes the die. They are hardened in water, drawn to a light straw color, and the top ground smooth on a grindstone, in water. This leaves the holes smooth and very sharp.

The stripper and gage are in one piece, and the work is held against the gage by light springs, near each punch, on the front side. The dies are not let into the bed quite their full thickness. The combined gage and stripper being screwed down upon them holds them in place. The holding-down screws are so located that any one die may be removed, without disturbing any other, by loosening the nearest screw and springing the stripper up a little.



FOR PUNCHING AND SHEARING SMALL SPRING STEEL.

Should the hole in the die become worn by use, so that the work comes off rough or with a slight burr, the stripper-holding screw is loosened and the die pushed in until a new hole is under the punch, the punch lowered until it enters the die, and the die carefully moved in or out until the punch, upon repeated trials, enters the die freely, when the holding screw is tightened and the work proceeds.

When the punch becomes worn or breaks off, it is removed and about ⅛ inch broken off to remove the worn or slivered end, the end again ground square and the punch returned to its place, the press being in its lowest position when the punch is clamped.

In setting both punch and die at the same time, the die is first slipped into place, the punch entered in the die and clamped, and then the stripper is tightened down on the die.

The punches are only fifty-one thousandths of an inch in diameter, and are a close fit in the dies, usually requiring a little pressure or a light blow on the upper end to force them into the die when both are new.

The sub-press shown sits under the gate of an old press that gives it the necessary motion, and an attachment automatically feeds the wire. The slide is disconnected when setting a punch or die, and can be easily moved by hand to feel if the punch enters the die properly.

We think this construction is unusual, and quite a departure from the accepted methods of holding dies and punches, but it serves the purpose admirably. The punches usually make from 1,000 to 5,000 holes without sharpening, and have at times made 10,000 holes each, at a rate of 110 per minute. The dies make from 5,000 to 50,000 holes for each hole in the die. A number of these sub-presses are in use for different lengths, styles and sizes of the pieces made from the steel. They have been used for about ten years, and are satisfactory in every way. The work is uniform, accurate to gage, and, considering the hard and trying nature of the material worked upon, is cheaply produced. The sketch is not made to scale, but shows approximate proportions and the relation of the parts.

C. E. QUIMBY.

The Columbus Meeting of the Society for the Promotion of Engineering Education.

The convention met in Townsend Hall, Ohio State University, Columbus, Ohio, on August 17, 18 and 19, in order to allow its members to attend the general meeting, in the ensuing week, August 21-26, of the American Association for the Advancement of Science, with which the engineering society is affiliated.

(*Continued on page 38.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant ; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming Lathes. Mer. Mach. T. Co., Meriden, Ct.

Punches & dies. Wal. M. Wks., Waltham, Mass.

Rawhide, fibre and hard rubber gears. The Arthur Co. (See page 8.)

Fountain blueprint brush mailed, $2. Edw. A. Osse, 134 S. Charles st., Baltimore, Md.

Light and fine mach'y to order ; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J. L. Lucas, Bridgeport, Ct. Send for index sheet.

Wanted—New or second-hand boring machine with 4½ or 5 in. bar. J. B. Poore, Scranton, Pa.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

Threads and gears ; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each ; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Gear and milling cutters, adjustable reamers and special tools ; vertical millers, cutter and surface grinder and shears. Catalog of small tools free. R. M. Clough, Tolland, Conn.

To take the place of T-square, we make fittings which you can apply to your drawing-board ; great thing for large boards ; send for circular. Leighton & Wisner, Watertown, Mass.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded ; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Position wanted by first-class planer hand ; competent to take charge. Box 246, A. MACH.

Mechanical draftsman wishes position ; New York or vicinity. Address Box 254, AMERICAN MACHINIST.

Wanted—Situation ; competent mechanical draftsman ; detail work preferred ; references. Box 233, AMERICAN MACHINIST.

Foundry foreman desires position ; experienced on engine, machine tool and general jobbing ; can give A1 ref. Box 226, A. MACH.

Technical engineer, 5 years' experience, going to Paris, would represent manufacturers or take charge of exhibit. Box 247, A. MACH.

Draftsman—Young man, 19, desires a position in drafting room of a machine shop ; has had 2½ years' experience. H. J. B., 548 W. 41st st., N. Y. City.

Machinist, used on tool work, would like to accompany machine exhibit to Paris Exposition ; speaks German, French and English ; was resident of Paris for two years. Box 252, AMERICAN MACHINIST.

Manufacturers—Are you dissatisfied with the management or output of your shop, or contemplate a change? Do you wish to systematize your shop on a modern basis? Address Box 249, AMERICAN MACHINIST.

Position as superintendent, assistant or master mechanic in manufacturing concern ; thorough experience in plant construction and operation ; technical graduate ; would invest some money. Box 222, AMER. MACHINIST.

(*Continued from page 37.*)

On Thursday morning, August 17, at 10 o'clock, Dr. Thomas C. Mendenhall opened the meeting with a notable address to the forty-seven distinguished engineering scholars of the society who attended from all parts of the country. He first dealt rather caustically with popular ignorance in some lines and the science of newspapers. A curious and instructive example of the readiness with which people accept newspaper science is found in an attempt made a year or two ago by the legislature of an enlightened State, to fix the value of the ratio of the circumference to the diameter of a circle by legislation. When first introduced it was taken humorously by the speaker of the House, who was a graduate of a widely-known college, and he ordered it referred to the Committee on Swamp Lands. It was reported back to the Committee on Education, and finally passed that branch of the legislature in which it was introduced by a good majority. The speaker developed humorously some of the popular fallacies and then came to the serious object of his paper, a plea for the adoption of the metric system. Dr. Mendenhall was universally complimented upon the direct practical import his paper carried.

On Friday the session was called to order by Vice-President C. Frank Allen, and five new members were elected.

Prof. J. P. Jackson, author of "Teaching Force Assigned per Student in the Several Divisions of a Technical College," was absent, and the paper was read by the secretary.

Dr. C. Frank Allen, of the Massachusetts Institute of Technology, then read a paper on "Method of Teaching; by Text Book, by Lecture, by Laboratory, by Design, by Memoir," and Prof. William T. Macgruder followed with a monograph upon a new system for a scientific worker, by which the data collected in his work and experiments may be preserved and filed so that it is well in hand. W. S. Aldrich, of the University of Illinois, next gave an able exposition of the new possibilities opening up to the profession by the spread in the dominion and trade of our country. Until recently Prof. Aldrich was assistant engineer on the United States naval repair ship "Vulcan." The title of his paper was "Engineering Education and Expansion." Four other papers were read in the afternoon; Prof. H. E. Smith's thesis on "Drawing, Mechanical Laboratory Practice and Shop Work in Engineering Colleges" being delivered by the secretary, Prof. Kingsbury in the author's absence.

The concluding session of the society opened promptly on Saturday morning, August 19, with a very large attendance, part of which was due to visitors from the various sections assembling for the American Association for the Advancement of Science. The first paper of the day was

(*Continued on page 39.*)

Situations Wanted—Cont'd.

Situation as foreman, by a first-class toolmaker; 15 years' experience as foreman in sheet-metal factories and on interchangeable machinery; Newark or Philadelphia vicinity preferred. Box 250, AMERICAN MACHINIST.

Wanted—Position as mechanical engineer or as chief draftsman; experienced on designing the heaviest class of machinery, plans for steam power plants and heavy mill work; has held last position for 7 years. Box 193, AMERICAN MACHINIST.

Desire to assist superintendent; am a persistent cost-reducer; thorough systematizer; not a machinist, but good mechanic, now working along these lines; want change; East preferred; shall we talk it over? Box 248, AMERICAN MACHINIST.

Wanted—Position as representative for some firm or firms exhibiting at the Paris Exhibition, by a mechanical engineer, speaking English, German and the Scandinavian languages, also familiar with French. Box 253, AMERICAN MACHINIST.

Situation Wanted—As superintendent or head draftsman, by mechanical engineer; 15 years' experience; specialty, development and duplication of light, intricate mechanisms; advanced methods; can handle large business. Box 235, AMERICAN MACHINIST.

Wanted—Position as manager or superintendent, in America or Europe, by an American who has had experience in organizing and systematizing, also in cutting costs, and is conversant with first-class shop practice; correspondence solicited. Address Box 244, AMERICAN MACHINIST.

Wanted—Position as foreman and toolkeeper in tool department; had 16 years' experience as such in four large concerns in this country, and held last resigned position for fully 6 years, to the satisfaction of employers; expensive tools tempered by myself. Address "Careful," AMERICAN MACHINIST.

Thorough business man, age 39, about to settle permanently in London, having been established several years in business in New York and London, will undertake to represent well-established, first-class American house desiring build up export trade; fluent French scholar; best New York and London references; only representative houses need reply. "Halo," care American Exporter, Bennett Building, Nassau st., New York.

Help Wanted.

Lathe hands; only first-class men. Apply by letter to Windsor Machine Co., Windsor, Vt.

Wanted—Three first-class tool makers on interchangeable work. The Blickensderfer Mfg. Co., Stamford, Conn.

Wanted—Good, all-round machinists on new and repair work; state age, experience and wages wanted. The Beall Machine Co., Cumberland, Md.

Wanted—Four draftsmen on mill work; good wages will be paid competent, experienced men. Address The Edison Portland Cement Co., Orange, N. J.

A good mechanical draftsman wanted for a position in the country. Address, stating experience, age, references and wages expected, Box 230, AMERICAN MACHINIST.

Wanted—A competent operator of a Jones & Lamson flat turret lathe, also a man to operate emery polishing wheels, by Taunton Locomotive Mfg. Co., Taunton, Mass.

Machine tool designer, thorough draftsman; excellent opportunity; salary according to ability; give age, experience and references. Address P. O. Box 88, Cincinnati, O.

Wanted—A competent mechanical draftsman; one with experience on printing presses preferred. Address, stating experience, wages and references, "Press," AMER. MACHINIST.

Wanted—An active and energetic man, about 30 years of age, for installing machine tools in a large plant now being built; give full particulars. N. Y. S., AMER. MACHINIST.

Machinists Wanted—One lathe man, several floor men; light machinery; country town 25 miles from New York; steady work for good men. Address Box 224, AM. MACH.

Wanted—Foreman for tool room working 6 to 8 men; must be up to date in originality, and hustle; state age, experience and wages expected. Send answer to Box 240, AMERICAN MACHINIST.

Wanted—Clerk in the office of a manufacturing establishment; must be quick and accurate at figures and have some knowledge of machinery drawing; state age, experience and wages wanted. The Beall Machine Co., Cumberland, Md.

Wanted—Machinist accustomed to erecting engines and pumps; will be required to erect machinery where it is used away from the shop; with application state wages per hour and give reference. Address Box 232, AMERICAN MACHINIST.

A man to make estimates for a shop engaged in light contract work; competent machinist preferred; must have worked in a prominent shop in a similar capacity; state age, experience, references and salary required. Box 231, AMERICAN MACHINIST.

Wanted—Competent field foreman for erecting pen-stocks, water towers, tanks, steel stacks, etc.; man must be expert at handling men and rigging; monthly salary and no lost time to right party; write full particulars. Struthers, Wells & Co., Warren, Pa.

Wanted — Expert draftsman, technical graduate, familiar with complicated mechanical movements, to transfer fully designed sketches to Patent Office boards; must have finished execution and ability to reproduce in miniature. Address Engineer, P. O. Box 53, Seabright, N. J.

Wanted—A thoroughly competent foundry foreman, for foundry employing 75 molders, on general machine and power-transmission castings; in answering give full particulars as to past experience; state age and salary expected; first-class position for first-class man. Box 251, AMERICAN MACHINIST.

Wanted—Salesman; must have had practical experience in all kinds of heat transmission by steam and feed-water heaters, radiators, condensers, evaporators, coolers, etc.; furnish references as to capability, character and experience; state salary expected. The Heat Transmission Co., 28-38 Maple ave., Danbury, Conn.

Wanted—First-class man, not over 45 years of age, as superintendent of an old-established manufacturing concern, located about 50 miles from New York City, employing 500 people, engaged in brass goods manufacturing; must understand modern factory methods. Apply by letter to Box 214, AMERICAN MACHINIST.

Draftsman and designer wanted at once; a man who is used to special machinery, and is capable of carrying the work along rapidly and at the lowest cost in the machine shop; this is a good position for the right man; send age, pay expected, experience and references; also good machinists wanted. Address Box 242, AMERICAN MACHINIST.

Wanted—A thoroughly informed toolmaker, not only up on small tools, but understands handling lathes, planers, etc., and knows their maximum capacity; must be familiar with modern methods and have practical ideas; to take position as assistant foreman when sufficiently acquainted with work. Box 225, AMERICAN MACHINIST.

Wanted—Experienced lathe, planer and vise men, also several men and boys who have done more or less machine work, by a high-grade machine tool company located near Milwaukee; shop is new, fitted with all modern conveniences, and is strictly up to date in every particular; steady work and opportunities for advancement to the right parties; write, stating wages expected, experience, age, etc. Box 221, AMERICAN MACHINIST.

CLEVELAND GEAR WORKS

W. R. SAWYER, Lessee.
86 Seneca Street,
CLEVELAND, OHIO.
Gear Wheels and Gear Cutting
Of all descriptions.
Get Our Prices.

"Save Us Their Cost Every Six Months"

is the testimony of one shop that has three
CROSS OIL FILTERS
in use. Better let us send you one on 30 days' trial. Booklet free.
The Burt Mfg. Co.
AKRON, OHIO, U.S.A.
Largest Manufacturers of Oil Filters in the world.

THE "NICHOLSON" HAS THE LARGEST PRODUCTION AND THE LARGEST SALE. DOESN'T THAT MEAN SOMETHING AS TO QUALITY?

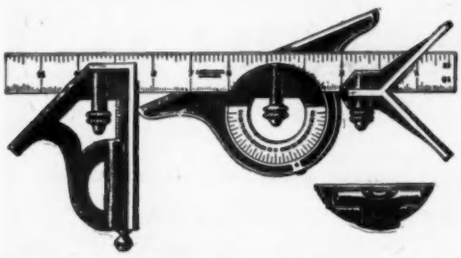
FILES

TELL YOUR STOREKEEPER THAT YOU WANT THEM.
NICHOLSON FILE COMPANY, PROVIDENCE, R. I., U. S. A.
LARGEST MAKERS IN THE WORLD.

Bevel Gears
Cut Theoretically Correct, Special facilities for cutting worm and spiral wheels.
Hugo Bilgram, Machinist,
440 N. 12th St., Philadelphia, Pa.

Foundry Molding Machines

STRIPPING PLATE MACHINES, PORTABLE AIR POWER MACHINES, using wood or metal split patterns, without stripping plates.
WRITE FOR INFORMATION.
The Tabor Manufacturing Co., Elizabeth N. J.



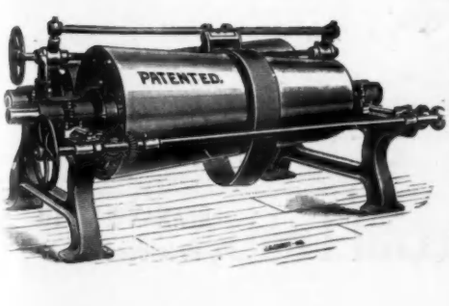
TOOLS FOR MACHINISTS
The Starrett No. 9 Combination Square.
Send for our Catalog of Machinists' Tools. The Starrett and Brown & Sharpe specialties.
Hammacher, Schlemmer & Co.,
209 BOWERY, NEW YORK.

FOR SALE—ON HAND
One 24 inch x 24 inch x 6 foot Pond Planer.
SECOND-HAND. CONDITION A1.
One 33 inch x 33 inch x 8 foot Planer. New.
Woodward & Powell Planer Company,
Manufacturers of Metal Planing Machines,
WORCESTER, MASS.

We Claim the Following Merits for ..... Jenkins Bros.' Valves.
1. Manufactured of the best Steam Metal.
2. No regrinding, therefore not constantly wearing out the Seat of the Valves.
3. Contains JENKINS DISC, which is suitable for all Pressures of Steam, Oil and Acids.
4. The Easiest Repaired, and all parts Interchangeable.
5. Every Valve Tested before leaving the factory.
6. ALL GENUINE stamped with Trade Mark.
Jenkins Brothers, New York, Philadelphia, Chicago, Boston.

Heat and Heat-Engines. A Study of the Principles which Underlie the Mechanical Engineering of a Power Plant. By FREDERICK REMSEN HUTTON, E.M., Ph.D., Professor of Mechanical Engineering at Columbia University. 559 pages. 8vo, cloth, $5.00. JOHN WILEY & SONS, 53 E. 10th St., New York City.

EVANS FRICTION CONES. NEARLY 6,000 SETS IN OPERATION IN THIS COUNTRY AND EUROPE.



The following is a partial list of Manufacturers who have Evans Friction Cone Pulleys in operation:

National Biscuit Co., Richmond, Ind.,	150 Sets, 6 H. P.
John & James Dobson, Philadelphia, Pa.	34 Sets, 2 H. P.
Samuel Cupples Co., St. Louis,	95 Sets, 3 H. P.
Atlas Cement Co., 143 Liberty St., New York,	8 Sets, 20 H. P.
Washburn & Moen, Worcester,	A large number, all sizes
Nonotuck Mills, Holyoke, Mass.,	16 Sets, 6 H. P.
Stinson Brothers, Carpet Mfgrs., Philadelphia,	40 Sets, 2 H. P.
Massasoit Paper Company, Holyoke, Mass.,	2 Sets, 40 H. P.
F. W. Bird, East Walpole, Mass.,	2 Sets, 40 H. P.
Arnold Print Works, North Adams, Mass.,	10 Sets, 6 H. P.
Merrimack Mills, Lowell, Mass.,	18 Sets, 10 H. P.
Dennison Mfg. Co., Mass.,	Large number.

C. W. BURTON, GRIFFITHS & Co., London Agents.
Send to G. F. EVANS, 85 Water Street, Boston, Mass., for Illustrated Catalog.

(Continued from page 38.)

a remarkably clear and logical exposition of the confusion which often results from the various symbols and technical expressions now used in engineering science, and urged all scholars to enforce a rigid uniformity of meaning in them. Dr. A. E. Haynes delivered this paper.

Prof. C. M. Woodward (recently elected president of the American Association for the Advancement of Science for 1900) was the author of the next paper read, on "The Use of Graphic Methods in the Solution of Problems in Mechanics"; and Albert Kingsbury, professor of mechanical engineering in New Hampshire College, then read the concluding paper of the meeting. Its title was "On the Nature of Entropy," and in, spite of its technical treatment, proved to be one of the best papers of the meeting.

Late in the day officers for next year were elected. They are: President, I. O. Baker, University of Illinois; vice-presidents, Robert Fletcher, Dartmouth College, and C. D. Marx, Leland Stanford University; treasurer, C. A. Waldo, Purdue University; and secretary, Edgar Marburg, University of Pennsylvania.

The features of this year's meeting were Dr. Mendenhall's address and the direct practical value of the papers in general. Twenty-nine new members were elected in all.

Personal.

Albert Hoppin, assistant general sales agent of the E. P. Allis Company at Chicago, has taken charge of the sales department of the Lake Erie Engineering Works at Erie, Pa., recently leased by that company.

Obituary.

Peter N. Nelson, machinist and engineer, died in this city August 29, seventy-seven years old. He was born at Le Grange, N. Y., and was apprenticed at the Matteawan Machine Works at fifteen years of age. He then worked at the West Point Foundry and in other shops, and rose to positions of responsibility. He made the models for the Bullock paper feeder, and the first of the ice-harvesting machinery now used on the Hudson. He was for many years in charge of repairs, and later indoor foreman at the Fulton Iron Works in this city. Later he was at the North River Iron Works, and finally he was engineer of one of the modern office buildings of the city, working until his death by apoplexy.

Manufacturers.

It is reported that the plant of Deere & Mansur Company, Moline, Ill., will be increased.

It is reported that the syndicate of Ohio capitalists that recently purchased the Ohio Falls Iron Works, at New Albany, Ind., will add to the plant a large steel and iron sheet

mill. The new plant will employ a large force of men and will turn out a high grade of sheet iron and sheet steel.

The Electric Street Car Company, Pensacola, Fla., is receiving bids for the construction of a new electric light and power house.

Robert H. Foerderer, at Philadelphia, Pa., will erect a three-story factory building, with one-story wing, at a cost of $110,000. The main building will be 38 by 712 feet, and the wing 180 by 253 feet.

W. E. Winner has had prepared and will present to the council at Leavenworth, Kan., it is said, an ordinance granting him a franchise for a power plant to be located there which will supply power for the entire system of roads, including not only the Leavenworth-Kansas City lines, but those to Atchison, Platte City, Lawrence and Topeka.

The Niagara Falls Power Company will, it is stated on the best of authority, build another power station that will in almost every particular be an exact counterpart of the present power house, and it is expected the work will be well under way before the close of this year. It will be of the same architectural design and will be able to furnish 50,000 horse-power.

Catalogs.

SO many people write us for Catalogs, we wish to announce that we are entirely out of them and will not have a new edition ready until about January, 1900.

In the meantime we shall be pleased to quote special prices on all classes of Tools, Supplies and Machinery. No trouble to quote and you may lose money by forgetting to have our prices. We have just opened a new show-room devoted to small machinery and carry a complete line of such tools as made by W. F. and John Barnes Co., Seneca Falls Mfg. Co., W. C. Young Mfg. Co., Builders Iron Foundry, etc.

Montgomery & Co.,

105 FULTON STREET, NEW YORK.

European inquiries should be addressed to our Paris House,
159 Rue du Faubourg Poissoniere, Paris, France.

A Can of_____

Dixon's
Pure Flake
Graphite

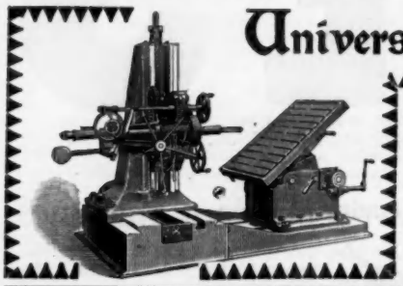
In engine or machine room will absolutely insure a saving of oil, a saving of time and a saving of labor.

Let us send you our pamphlet showing how it is done.

Jos. Dixon Crucible Company,
Jersey City, N. J.

NEW JERSEY MACHINE WORKS,
WILLIAM TYACK, Jr., PRESIDENT,
BUILDERS OF
ALL CLASSES OF MACHINERY
Also Builders of Steam and Gas Engines.
NEWARK, N. J., U.S.A.

NEW SURFACE GAUGE
No. 100
PERFECT ADJUSTMENT.
UNEQUALLED SCOPE.
Price with 6 and 10 inch spindle, $2.50.
MADE BY THE
SAWYER TOOL CO.,
FITCHBURG, MASS.



Universal Horizontal Drill.

Five sides of a cube can be drilled at any angle without re-chucking the work.

Write
Detrick & Harvey Machine Co.,
Baltimore, Md., U. S. A.

GRINDING UP MONEY.

In using soft abrasives you are grinding up money that you might save.

CARBORUNDUM

is the best abrasive because it is the hardest substance known excepting the diamond.

It is made up in many forms, embracing crude crystals, grains and powders, wheels, sticks, knife sharpeners, hones and bricks, paper and cloth, and dental goods.

THE CARBORUNDUM CO., NIAGARA FALLS, N.Y.

Mossberg & Granville Mfg. Co.

3 B Power Press, with Automatic Power, Roll Feed, with Top Roll Lifting Device.

POWER PRESSES,
With Automatic Feeds,

Drop Presses,
Rolling Mills,
Wire Drawing Machinery and
Roller Bearings.

Catalog on Application.

PROVIDENCE, R. I.

New York Office,
126 Liberty St.

Exhibit at Philadelphia Bourse.
McDowell, Stocker & Co., 61 South Canal St., Chicago, Ill.
Chandler & Farquhar, 36 Federal St., Boston, Mass.
U. Baird Machinery Co., Pittsburg, Pa.
E. A. Kinsey Co., Cincinnati, Ohio.
Kowalewski & Kuesch, 44 Green St., Newark, N. J.

Foreign Agents:
Chas. Churchill & Co., Ltd., London and Birmingham, England; Adolphe Janssens, 16 Place de la Republique, Paris, France; A. Mathey-Doret, La Chaux-de-Fonds, Switzerland; De Fries & Co., Dusseldorf and Berlin, Germany, Vienna, Austria.

We Make Boring Machines, Milling Machines, Special Tools, BEAMAN & SMITH, Providence, R. I.